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Number 2

Mariners Weather Log

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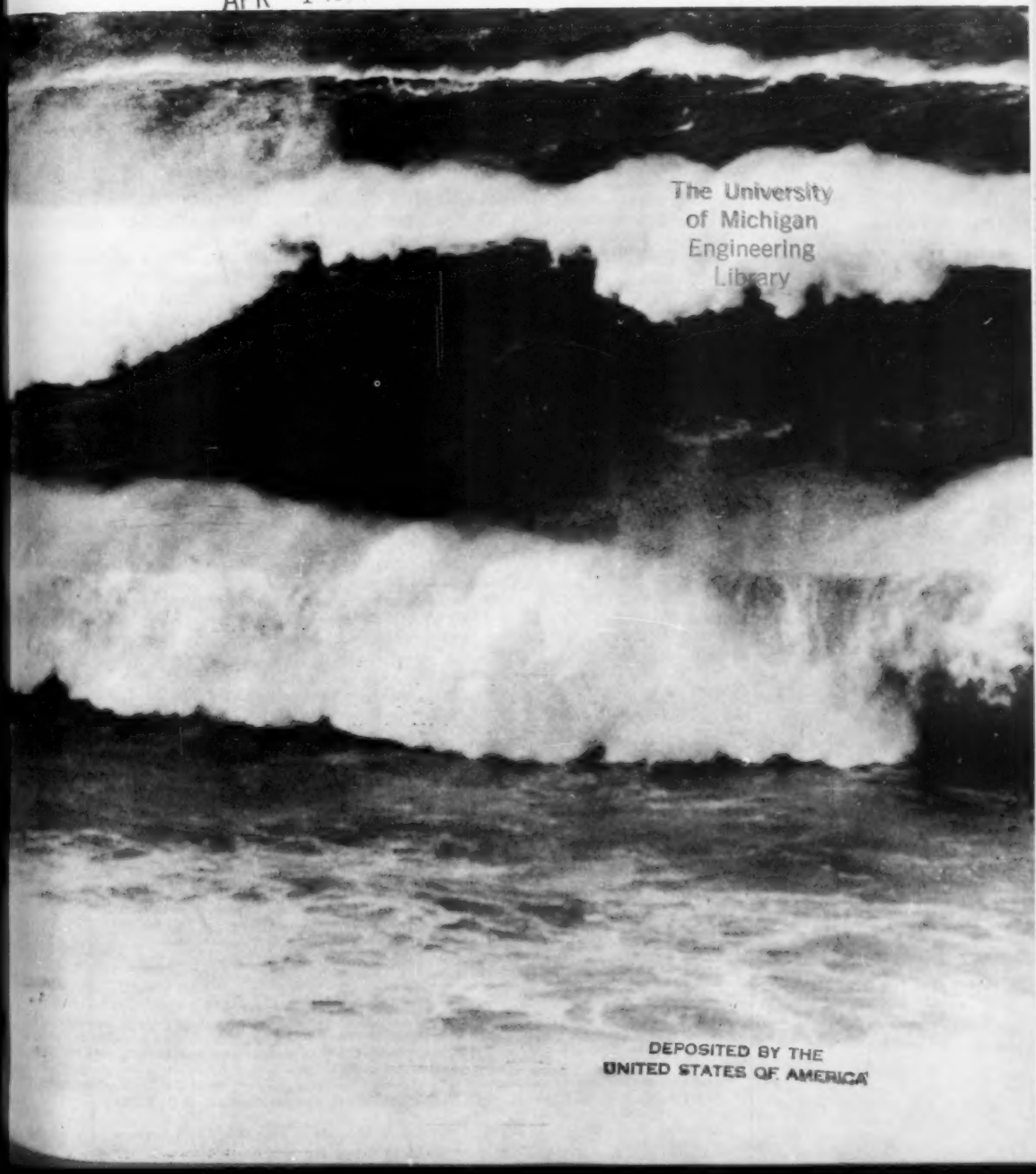

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Cover: A monster surf pounds the north shore of Oahu on January 7, at the popular surfing site, Waimea Bay. An intense winter storm produced waves up to 35 ft, causing widespread damage throughout the Hawaiian Islands. See page 138 for a description of this storm. United Press International Photo.

Mariners Weather Log

Editor: Elwyn E. Wilson

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March 1974
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PLEASE PASS THIS ISSUE ALONG

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget, July 26, 1973.

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Mariners Weather Log

DANGERS OF OCEAN SAILING AS ENCOUNTERED BY PATTI 1

Edward J. Bergin and O. Jack Buchanek
U.S. Department of Labor
Washington, D.C.

The best advice we ever received about ocean sailing, unfortunately, came too late to save our dreams and Ed's 35-ft new ketch PATTI I (fig. 1).

Editor Bill Robinson, writing in the December 1973 issue of Yachting Magazine, warned small-boat sailors about the dangers of the North Atlantic in late fall. The recurring problem concerns offshore passages from northeastern North America to the West Indies via Bermuda in the September-December period.

Robinson tells of a modern stock 41-ft fiberglass sloop enroute from Maine to Bermuda which foundered 250 mi east of Cape Hatteras. The crew evidently was injured by the battering around inside the boat and was taken off by a merchant ship. The boat was abandoned. It is asking for trouble to head south by this route, from the onset of the hurricane season through the fall and winter. The preferred route is to follow the coast to south of Cape Hatteras in late October and then head for the islands from Morehead, N.C.

As to Robinson's advice, we think he would have done us more of a service to run his editorial in June or July. As it turned out, his editorial was almost our post mortem. By the time we read his column, we had:

- lost a 35-ft fiberglass ketch to a series of North Atlantic gales,
- been rescued by the USNS NORWALK and taken to Holy Loch, Scotland, and
- learned one heck of a lot about small-boat survival tactics and equipment.

To begin with, the boat, PATTI I, was a United States documentated pleasure yacht of 11 tons gross. She was a U.S.-built stock Coronado 35 sailboat, with a 30-horsepower inboard gas auxiliary engine.

The crew consisted of the authors and another mutual friend, Ron Grandon, all from the Washington, D.C., area. All of us owned sailboats and were experienced Chesapeake Bay sailors. None, however, had previously sailed the ocean.

Before leaving the Bay, we carefully provisioned and equipped ourselves and the boat. Among the major preparations were:

- learning celestial navigation,
- adding an anchor winch and chain,
- purchasing a Plath micrometer sextant, a Radio Direction Finder, and a Winslow 4-man liferaft (in valise, not canister),
- mounting 1/2-in plexiglass sections over the cabin windows, through-bolted from the outside

Figure 1.--The yacht PATTI I before leaving port. Note the high freeboard, which added buoyancy.

for strength, and

- purchasing an auxiliary gasoline-powered generator, spare engine parts, rigging tools, man overboard pole, and a time and weather signal receiver.

The boat and crew were pretty thoroughly tested, even before leaving the relative safety of the Chesapeake. We left the dock area in Solomons, Md., on the Patuxent River, October 30, accompanied by brisk 25-kt winds.

The last 67 mi south to Norfolk from the Potomac River were under storm jib, because of a 40-kt gale. The 8- to 10-ft bay chop and howling winds built up false confidence, because we were still able to make our course.

We left Norfolk on November 3 (fig. 2), after receiving an "all clear on the radar screen" weather picture from the Coast Guard. We filed our sailing plan with them, notifying them of our intention to sail eastward past Bermuda and then southward to the West Indies.

We sailed out of Chesapeake Bay about the time that Yachting Editor Robinson was writing that relatively experienced yachtsmen who have never gone through extreme conditions offshore in cold weather have no idea of how rugged it can be and how much abuse humans have to suffer.

On November 4, after a 130-mi easterly run for 24 hr, we began noticing large swells, much larger than a 20-kt wind would normally produce.

Later, on the 5th, we received a gale warning on our radio, tuned to WWV, Fort Collins, Colo., on 5 mHz. This is the National Bureau of Standards Time Signal Station. The forecast said that the storm center was located over Eastern Tennessee, near 36°N, 86°W, at 0600, and would move east-northeastward at 35 kt for the first 24 hr and then turn northeastward at 20 kt. The forecast for the mid-Atlantic Coast was for winds increasing to 25 to 40 kt in the west quadrant within 450 mi of the storm center.

A check with the weather maps ashore leads us to believe that this storm reached us November 5, peaked November 6, and began abating November 7. Our estimated position at the time this storm reached us on the 6th was 37°N, 72°W.

As far as small yachtsmen were concerned, we found that the National Weather Service broadcasts out of Fort Collins were inadequate. For example, the key information (storm center coordinates, speed of advance, expected conditions) is only reported once. With the interference on the radio and the general noise level of a small sailboat working in heavy winds and seas, we found it nearly impossible to accurately record the information we needed. (See editor's note

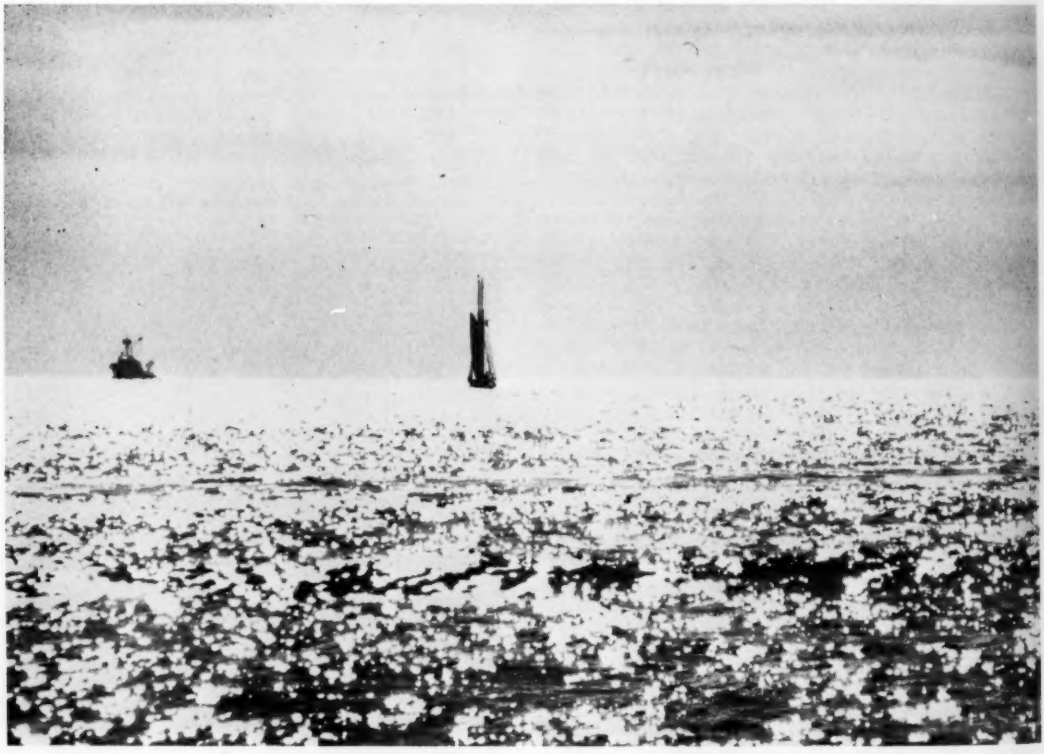

Figure 2.--Conditions were fine as the PATTI I departed Norfolk on an easterly run toward Bermuda.

at end of the article for comments on the synoptic situation and radio services.)

So without a SSB (single side band) radio, a major error of omission, we were not able to get really adequate weather information.

By Monday, November 5, the seas and winds became too rough to continue sailing. Sustained winds were approaching 40 kt and probably gusting to 60 kt, and the seas were building to 20 ft and higher (fig. 3).

At first, we hove to, lying under a double-reefed mainsail. For the first day, this tactic worked well and kept the high seas forward.

By Tuesday, the 6th, the winds were screaming upwards to perhaps 65-kt gusts, and the seas were averaging 20 ft, with occasional monsters of 30 to 35 ft. The mainsail was being ripped out, and we were afraid the rigging would collapse if we continued to carry sail. We doused the mainsail and went with a sea anchor streamed aft. The sea anchor did not keep the yacht head to the seas, as we had hoped; still, the seas were being taken forward of the beam, and the yacht was not sustaining any damage.

That night, the sea anchor chafed through the 5/8-in nylon warp that tied it to the stern and we began to take the seas directly on the beam. Streaming warps and makeshift sea anchors (boat pails, fender boards, etc.) failed to bring her into the wind, and, during the night, she took a number of staggering blows.

The gale reached peak intensity on the 6th. The PATTI I was constantly being pounded by high seas (fig. 4). We decided we could no longer "lie-a-hull" and instead would try running before the storm under bare poles. This tactic had been described in Adlard Cole's excellent book, "Heavy Weather Sailing."

Jack stayed down below, to bail water, while Ron and Ed went on deck. While Ed steered the yacht (or rather, fought the unresponsive wheel), Ron was looking behind to tell him which way to turn the boat to present the stern to the next wave.

Ed looked back once. He knew then why the helmsmen of the old clipper ships were told "never look back" when caught in a severe blow. From the deck of a small yacht, the fury of the North Atlantic's graybeard waves roaring and curling down on you can virtually frighten you to the point of paralysis.

The PATTI I, with her slabsided hull and high freeboard, buoyantly rose to each challenging wave, hit the crest, and, like an 11-ton roller coaster, swooshed down the face of the breakers to the trough. We tried desperately to keep the stern to the seas.

The helmsman and lookout had to be constantly alert for the maverick wave, which can roar in nearly at right angles to your heading. A little later, a maverick wave slammed into our side, turning us beam to the seas, and set us up as a sitting duck.

The next wave, a monster probably over 35 ft,

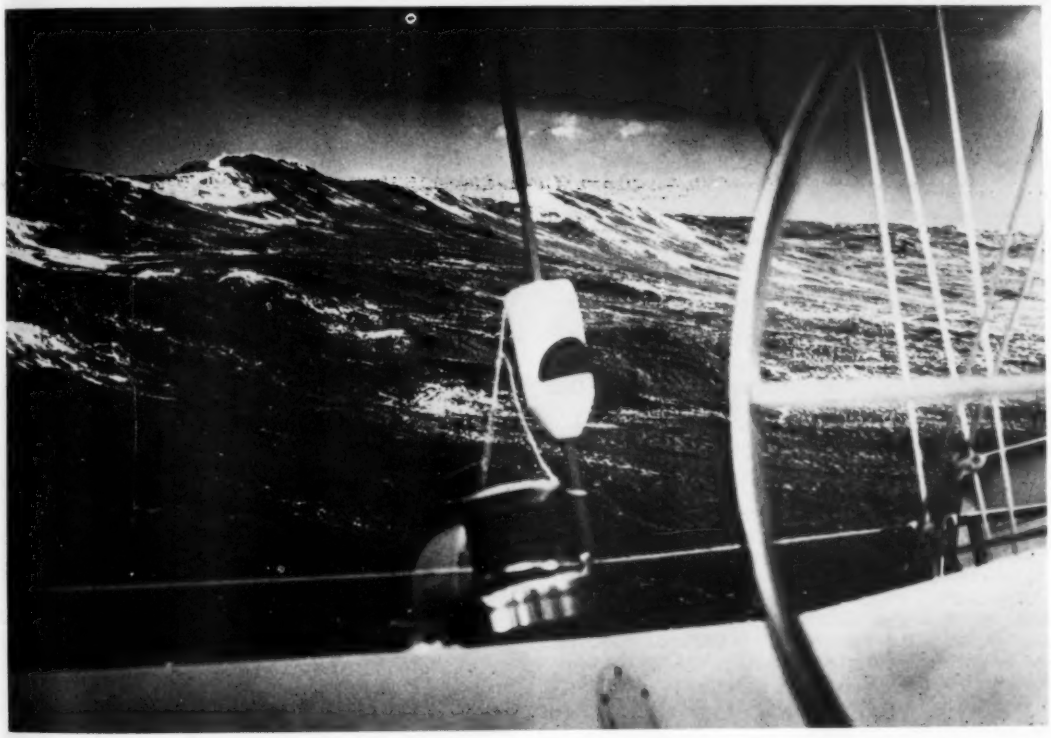

Figure 3.--This is what 20-ft waves look like from the deck of a small yacht. Note the man overboard pole and ring buoy (partially visible), which should be standard equipment on any small craft going to sea.

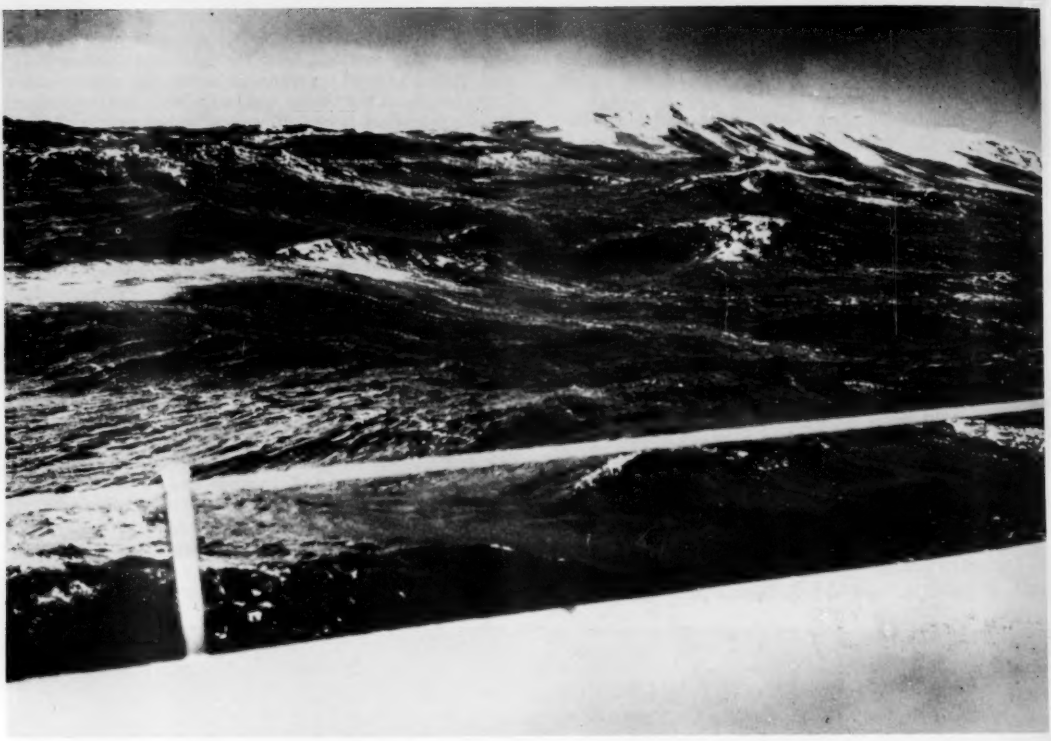

Figure 4.--Seas continued to build on the 6th, and it was necessary to run before them under bare poles.

crashed into us, capsizing the ship, throwing her on her beam-ends down the face of a breaking sea. Ed was torn from the wheel and thrown into the sea through two sets of lifelines, flattening one stanchion in the process.

In a prescient and lifesaving moment, 4 days earlier, he had rigged an auxiliary lifeline (fig. 5) from the bow cleats to the stern cleats on both sides. Although the lifelines parted under the stress, the auxiliary lifeline held and, when the ship finally rolled back upright, Ron helped him back on deck.

Down below, Jack had been violently thrown the length of the cabin. How he managed to smash through a 2-in-square teak bulkhead pillar without being seriously injured still remains a mystery.

The batteries were thrown from their fiberglass mounts, one shorting out the other. Water poured in from everywhere. Jack secured the batteries, probably preventing a disastrous fire.

The PATTI I had been staggered, but she was not finished. The mast had been at least 5 ft under the sea. The rigging that held it up had been stretched and some turnbuckle threads stripped. The mizzen sail, furled on its boom, was swept away, along with an 8-ft fiberglass dinghy and two teak boxes that vented the main cabin.

The hull and deck joint opened up along the starboard side, and the hull was cracking where the chain plates were bolted into the mainmast shrouds and stays. When you add the fact that our engine was knocked out and our mainsail was badly damaged, you begin to realize the gravity of our situation.

Through the 6th and 7th, the storm continued. We streamed warps to try to get the boat to lie head to the seas, but she presented her beam to the breakers and continued to receive punishment. The teak bulkheads were all smashed in by the flexing of the fiberglass hull, as the waves smashed into the boat.

The liferaft, rolled up in a flimsy-looking handbag, certainly did not inspire much confidence, as we mentally prepared for the steps we would have to take if the ship rolled clear over and filled with water. We had put together a separate survival pack in a canvas knapsack, consisting of food, canned water, signal-flares, mirror, compass, chart, fishing equipment, first aid kit, and signal light. However, getting this (let alone ourselves) on and into a liferaft in 20-ft breaking seas presented a difficult problem.

Although we had nearly 3 days to visualize the problem, we developed no real solutions. The deck-mounted canister liferafts can be tied to a foundering vessel with a painter and then inflated while still tethered to the mother ship. These liferafts also have survival rations, etc., stored inside them. A valise raft, on the other hand, might be inflated while still on deck; however, a breaking sea could smash the survival craft into the rigging and render it virtually unseaworthy before launching. However

Figure 5.--Jack Buchanek at the wheel of the PATTI I on a calmer day, prior to the trip. Note the safety harness with the auxilliary lifeline attached. A ring buoy and the man overboard pole are also visible.

grim the prospects of launching a raft might be, we were fortunate that we did not have to attempt it in heavy seas.

On November 8, in fact, the storm abated and we were able to carry a small storm jib. We did not risk any more canvas because of the uncertain state of the rigging and turnbuckles holding up the mainmast.

Our luck, however, did not last long. By the 10th, we had received another storm warning from radio WWV. This one concerned a trough extending southwest through 32°N, 57°W, which was predicted to have winds up to 45 kt.

On the morning of the 11th, the barometer, which had risen slightly, was again dropping, and the wind and seas began building up. By the time this storm center reached us, our estimated position was 36°N, 68°W.

Sunday, the 11th, we tried to get underway in heavy seas of 15 ft and 25-kt winds, running again before the storm under bare poles.

In the late afternoon, around 4 p.m., we sighted an orange-hulled coastal vessel. We lit a signal flare and hoisted an orange distress flag. The ship appeared to change course, circled lazily about 2 mi away, and then cruised off, apparently unconcerned.

There is nothing more bitter and frustrating than to be signaling for help in a small foundering yacht in heavy seas and have a large vessel sight you and fail to render assistance. I hope that captain realizes sometime, somewhere, he could be the one needing rescue.

Later, just before nightfall, a freighter spotted our signal flare. We believe the ship was the MONTE SAPPOLLO, of Spanish registry, headed for Barcelona. The skipper tried to come alongside, but the windage on the large hull blew the freighter faster downwind than we could go.

Meanwhile, the USNS NORWALK, under the able command of Capt. Peter S. Gentile, arrived on the scene and informed the MONTE SAPOLLO via radio that he (with a smaller, more maneuverable ship) would try to come alongside and make the rescue.

We headed into the wind while the NORWALK expertly came abeam, cut her engines, and slowly drifted downwind. Despite the rough seas, lines were made fast and, at 11 p.m., November 11, we scrambled up the bouncing Jacob's Ladder with our dreams shattered, but our lives saved.

Well, what did we learn as a result of all this?

- The North Atlantic in late fall is no place for even a well-found small yacht.
- A small storm trysail is worth having aboard, and can help keep a small yacht head to seas in high winds.
- Sea anchors should be shackled to the boat with a chafe-proof warp (possibly a small length of vinyl-coated chain).
- Liferafts should be the kind packed on deck in a canister, with survival rations inside.
- SSB radios are necessary for long ocean passages.
- Worldwide Marine Weather Broadcasts should be consulted for weather broadcast scheduling.
- Small-boat buyers who plan to go to sea would be well advised to buy boats that qualify for Lloyd's A-1 hull molding certificates.
- Weather information is too sparse for small craft; in any case, coordinates should be repeated s-l-o-w-l-y, so they can be recorded.
- Pre-departure weather checks should be obtained from the nearest National Weather Service Marine Forecast Office,and climatological sources should be consulted during the planning stages.
- When climbing up a boarding ladder in heavy seas during a rescue attempt, always catch the Jacob's Ladder at the top of the crests.
- The plexiglass sheeting over the windows was definitely a good investment.
- Supplemental lifelines are a good idea (stanchions and lifelines can and do fold under pressure).

- Safety harnesses should be worn at all times (once the habit is formed, they don't get in the way).

- It is in every seaman's self interest to render assistance to a stricken vessel. You might be next. (I'll bet even a 40-ft sailboat would seem like heaven to a freighter skipper if his alternative was a liferaft.)

The Captain, officers, and crew of the NORWALK treated us handsomely. We commend their seamanship and their hospitality. Perhaps, even more importantly, they seemed to understand our situation. As far as we are concerned, the more Navy ships at sea (and the more Capt. Gentiles), the better.

Editor's Note: The hourly Radio WWV weather information broadcasts are transmitted in three 45-sec time segments, which are separated by 1-min, 15-sec intervals. This hourly broadcast commences at 8 min past each hour. Such a short broadcast period doesn't allow time for repetition of data. However, the user can tune in at hourly intervals and fill in any information not heard on earlier broadcasts. (On July 1, 1974, the weather segments of the broadcasts will be separated by only 15 sec.)

Persons contemplating open ocean sailing or boating should consult the many climatological information sources well ahead of time in their initial planning to determine routing and time of year. These sources include the Defense Mapping Agency Pilot Charts and Sailing Directions; National Ocean Survey Coast Pilots; Summary of Synoptic Meteorological Observations; and various marine atlases. This is by no means a complete listing of available marine meteorological references. The closest National Weather Service Marine Forecast Office should be contacted for climatic and forecast information.

Marine climatological information can be obtained by contacting the "Marine Climatological Services Branch,"

National Oceanographic Data Center, D762
3300 Whitehaven St., NW
Washington, D.C. 20235
Telephone: 202-343-7614

or from the "Applied Climatology Branch,"

National Climatic Center, D531
Federal Building
Asheville, N.C. 28801
Telephone: 704-254-0961, ext. 0765

This is a synopsis of the weather during the PATTI I voyage from Norfolk on the 3d to the point of rescue on the 12th (11 p.m., 11th).

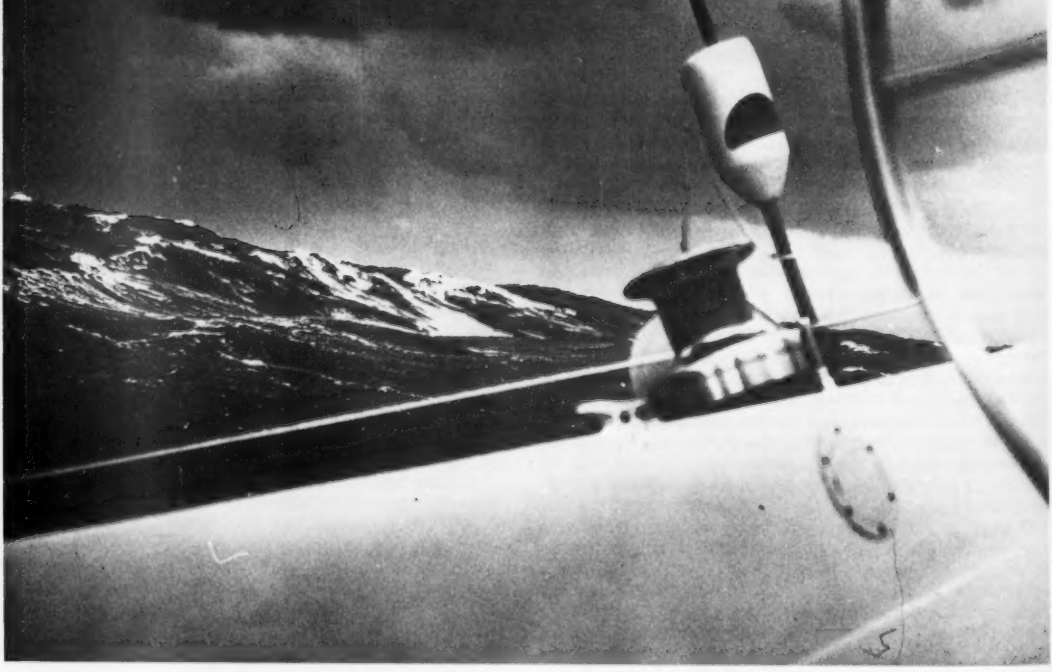

Figure 6.--These dark cumulus clouds that produced the rainshowers and squally weather encountered by the crew are a stark background against the whitecaps.

At 1200 on the 3d, a 975-mb LOW was just west of Belle Isle. A frontal wave was over Nova Scotia. The cold front extended southwestward and crossed the coast near Wallops Island, Va. By 0000 on the 4th, the cold front was well out into the Atlantic and paralleled 34°N between 70° and 75°W. That day, the winds reported by ships and buoys east of Norfolk out to 70°W were 10 to 15 kt out of the north to northwest. Early on the 5th, a small HIGH was centered about 100 mi off Cape Hatteras.

The LOW that was in eastern Tennessee at 0600 on the 5th moved off the coast about 1500 and, at 1800 on the 5th, the 1009-mb LOW was near 37°N, 72°W, the estimated position of PATTI I on the 6th. At 1800 on the 5th, Ocean Station Vessel "H" and the WILLIAM R. ADAMS, north and southeast of the LOW, respectively, both reported 20-kt winds. As the LOW moved east-northeastward and deepened, ships reported 20- to 25-kt winds and a maximum of 7-ft seas until 1200 on the 6th, when the wind and seas increased. At 1800, Ocean Station Vessel "H" and another ship upwind from their position had 30-kt winds and 10- to 12-ft seas. To the southeast near 34.5°N, 67°W, the PULA reported 45-kt winds and 21-ft seas. Many ships were reporting rain, rainshowers, and cumulus type clouds. One ship at 36°N, 66.5°W, reported a thunderstorm. The weather behind the front and near the Gulf Stream appeared very squally (fig. 6). At 0000 on the 7th, the PULA was at 35°N, 68°W, with 35-kt winds and seas of 13 ft. Hotel reported 30-kt winds and 12-ft seas. The LOW had raced to about 48°N, 47°W, east of Newfoundland.

Northwesterly and west-northwesterly winds of 20 to 40 kt were reported on the 7th by ships in the general area where the PATTI I was probably located. The weather continued to be squally, with showers and cumulus clouds. At 1200 and 1800, the HOI ENDRECHT reported 35- and 40-kt winds and 10- to 13-ft seas, with 13-ft swells on the 1800 report, near 37°N, 66°W. At that same time, Hotel was measuring 25- to 30-kt winds and 8- to 12-ft seas. Early on the 8th, a small HIGH moved southeastward over Cape Hatteras. The LOW was moving into the Denmark Strait. The gradient loosened considerably, and winds were generally 10 to 20 kt, seas and swells were 7 to 8 ft.

On the 9th, another cold front moved east and southeastward off the coast. There were ship reports of 30- to 35-[illegible] winds and 5- to 12-ft seas and swells ahead of the front, in the vicinity of the yacht's position. This front passed over them sometime on the 10th, with about the same winds and waves, but their direction shifted from the southwest to the northwest.

After the front passed Bermuda, a significant wave formed on the 11th and moved northeastward. Another HIGH was moving eastward over Cape Hatteras. On the 11th, the winds were generally northerly at 10 to 15 kt. Waves were still 5 to 10 ft, and squally type weather was reported. The 0000 chart of the 12th indicated winds of 15 to 20 kt and seas and swells of 5 to 8 ft, west of 65°W. East of 65°W, closer to the LOW, 30- to 35-kt winds were reported, with 8- to 15-ft seas and swells. The NORWALK reported northerly winds at 22 kt, with 5-ft seas and 5-ft swells, at 0000 on the 12th. At 0600, she reported 25-kt winds and the same sea and swells.

Other ship reports available are listed in table 1.

Table 1.--Excerpts of ship observations in the vicinity of the PATTI I, received at the National Climatic Center.

Ship	Lat.(°N)	Long.(°W)	Day	Time	Wind (kt)	Sea (ft)	Swell (ft)
MORMACLAKE	32.2	66.8	06	00	35	5	13
	36.1	68.7	06	06	35	5	13
	36.7	69.9	06	12	30	5	13
	37.6	70.8	06	18	40	5	15
	38.7	72.0	07	00	30	5	15
MOS GULF	35.7	67.9	05	18	15	-	-
	35.9	66.1	06	00	30	-	-
	36.1	64.2	06	06	40	23	-
CARCHESTER	40.0	67.9	07	06	29	10	13
	39.7	68.8	07	12	27	7	12
	38.9	69.7	07	18	27	8	12
NORBROTT	36.5	68.4	05	18	17	3	13
	36.6	70.0	06	00	16	3	-
	36.7	73.2	06	12	40	10	-
AUSTRAL PATRIOT	36.2	60.5	06	06	40	8	13
	37.4	62.9	06	12	30	30	18
	38.3	64.9	06	18	35	10	18
LOUISE	34.2	62.3	06	12	27	16	20
	35.5	62.5	06	18	34	16	16
	36.1	62.9	07	00	40	16	20
	37.2	63.0	07	06	33	16	20
EXPORT BUILDER	38.5	68.9	11	12	18	5	5
	39.5	71.5	11	18	15	3	-
OGDEN WABASH	31.7	71.2	12	00	30	5	10
	33.4	71.8	12	06	02	5	10
NORWALK	34.6	69.4	11	18	25	5	5
	35.0	67.7	12	00	22	5	5
	35.2	66.1	12	06	25	5	5

EASTERN NORTH PACIFIC TROPICAL CYCLONES, 1973

Eastern and Central Pacific Hurricane Centers
San Francisco, Calif., and Honolulu, Hawaii

Tropical cyclone activity in the eastern North Pacific Ocean began June 1 and continued through October 9. It was one of the least active seasons since information from operational satellites, which completely cover the tropical areas, became available to field stations in 1966. A total of six tropical depressions, five tropical storms, and seven hurricanes (table 2) required the issuance of 106 bulletins and 195 advisories. Storm activity for 1973 and earlier years is shown in tables 3 and 4.

Reconnaissance flights into the storm areas were conducted by the U.S. Air Force 32 times, on 29 flights. Doreen and Emily were investigated July 22 by separate aircraft, and Doreen was investigated twice by the same aircraft July 20. An average of 15 enroute observations were made on each flight.

The primary source of data in observing tropical cyclones during 1973 was from ESSA-8 and NOAA-2 satellites. ESSA-8 visible and NOAA-2 visible and infrared pictures were monitored midmornings and NOAA-2 infrared in the evenings (approximately 1700 and 0500, plus or minus 1 hr and 50 min), depending on the location of the storm. In addition, a Mercator projection satellite picture readout of tropical areas was received on facsimile circuits from the National Environmental Satellite Service (NESS) for each day and night pass.

NESS supplied daily estimated positions, intensity, and movement using the Dvorak format. Special bulletins were transmitted via teletypewriter when new systems were first observed or where marked changes in intensity or location were indicated. A total of 70 Satellite Weather Bulletins were received from NESS, in addition to a daily summary of convective activity and Intertropical Convergence Zone (ITCZ) location in the eastern North Pacific Ocean.

The Global Weather Center, Offutt Air Force Base, Omaha, Nebr., supplied daily information on developing, active, and dissipating storms from the Data Acquisition and Processing Program (DAPP) satellite. One message a day was received, beginning in mid-August. The Air Force and NESS interpretations of storm location and intensity from the different series of satellites appeared to agree very well, although no direct correlation was attempted. Locations, when extrapolated for different passage times, agreed well in all but weak systems.

The National Hurricane Center, Coral Gables, Fla., was consulted at times, especially for "first light" information for morning advisories. Their receipt of Advance Technology Series 3 (ATS-3) pictures made information available about an hour earlier than from locally obtained pictures.

While satellite pictures gave good location and intensity estimates, aircraft reconnaissance of storms gave the most accurate data. Storm center location was most often within 10 mi, but varied upwards from within 1 mi, when navigational accuracy was precise and the eye was small and well defined.

Table 2.--Monthly distribution of tropical storms and hurricanes, 1973

	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Tropical storms*	0	2	1	1	1	0	0	5
Hurricanes*	0	1	3	0	2	1	0	7
Total	0	3	4	1	3	1	0	12

*Tropical cyclones are counted for the month in which they formed.

Table 3.--Frequency of tropical storms and hurricanes combined by months and years

Year	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
1966	0	1	0	4	6	2	0	13
1967	0	3	4	4	3	3	0	17
1968	0	1	4	8	3	3	0	19
1969	0	0	3	2	4	1	0	10
1970	1	3	6	4	1	2	1	18
1971	1	1	7	4	2	2	1	18
1972	1	0	1	6	2	1	1	12
1973	0	3	4	1	3	1	0	12
Total	3	12	29	31	24	15	3	119
Average	.4	1.5	3.6	3.9	3.0	1.9	.4	14.9

Table 4.--Frequency of tropical storms reaching hurricane intensity by months and years

Year	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
1966	0	1	0	4	2	0	0	7
1967	0	1	0	2	1	2	0	6
1968	0	0	0	3	2	1	0	6
1969	0	0	1	1	1	1	0	4
1970	1	0	1	1	0	1	0	4
1971	1	1	5	2	2	1	0	12
1972	1	0	0	6	1	0	0	8
1973	0	1	3	0	2	1	0	7
Total	3	4	10	19	11	7	0	54
Average	.4	.5	1.3	2.4	1.4	.9	0	6.8

The most sophisticated reconnaissance of an eastern North Pacific hurricane occurred with Ava, when she was about 300 mi southwest of Acapulco on June 6. NOAA research aircraft entered the storm area with radiometric sensors to measure sea heights from various altitudes, between 500 and 1,000 ft, finding measured winds increasing from 60 to 137 kt over a line of about 4 mi in length. Sea heights of 40 ft were measured by a 13 gHz passive microwave system and by a laser altimeter. (For additional details, see page 296 of the September 1973 issue of the Mariners Weather Log.) Instruments installed in Skylab, which passed directly over the center of the storm at an altitude of 270 mi, made similar measurements. At nearly the same time, U.S. Air Force reconnaissance was being conducted at 10,000 ft, using dropsondes to measure temperature and moisture qualities of the air in the eye of the storm. A 915-mb

Table 5.--Summary of eastern North Pacific tropical cyclones, 1973

Name and intensity	Lifespan	Origin (°N, °W)	Dissipation (°N, °W)	Highest reported wind speed (kt)	Estimated satellite maximum wind speed (kt)	Lowest reported pressure	Coasts affected	Remarks
Hurricane Ava	June 1-12	11.4, 94.5	17.0, 131.0	137 11.9°N, 107.5°W USAF recon	140 6/7/73 Satellite	915 mb 11.9°N, 107.5°W USAF recon	None	First hurricane measured sea conditions by radiometric means.
Tropical storm Bernice	June 21-23	13.0, 97.0	18.0, 102.2	60 16.7°N, 101.3°W USAF recon	60 6/23/73 Satellite	990 mb 16.7°N, 101.3°W USAF recon	Coastal area, Zihuantenejo, Mexico	No damage reported.
Tropical storm Claudia	June 25-28	10.0, 95.0	17.0, 100.1	40 16.0°N, 99.6°W USAF recon	55 6/28/73 Satellite	999 mb 16.0°N, 99.6°W USAF recon	Coastal area near Acapulco, Mexico.	No damage reported.
Hurricane Doreen	July 17-August 3	10.3, 105.4	19.4, 173.3	120 14.1°N, 121.4°W USAF recon	130 7/20/73 Satellite	972 mb 14.3°N, 121.9°W USAF recon	None	CORNELIA lost its rudder on 27th, in 52-kt winds and 35-ft waves.
Hurricane Emily	July 21-28	13.0, 96.0	22.0, 123.0	110 15.8°N, 103.8°W USAF recon	110 7/23/73 Satellite	972 mb 17.1°N, 108.2°W USAF recon	None	None
Hurricane Florence	July 25-30	12.8, 94.0	20.5, 115.5	70 17.5°N, 107.6°W USAF recon	80 7/28/73 Satellite	990 mb 17.5°N, 107.6°W USAF recon	Passed 90 mi south Clarion Is. 7/29	None
Tropical storm Gleada	July 30-August 5	11.3, 100.0	21.0, 124.0	40 17.3°N, 122.4°W TOYOTA MARU	50 7/31/73 Satellite	989 mb 17.3°N, 107.6°W TOYOTA MARU	None	None
Tropical storm Heather	August 31-September 1	14.0, 94.5	15.5, 95.5	54 15.4°N, 95.6°W TEXAN	45 8/31/73 Satellite	1005 mb 14.3°N, 94.9°W JFIL	Coastal area, Gulf of Tehuantepec	None
Hurricane Irah	September 21-26	13.0, 101.0	25.8, 109.0	70 22.4°N, 109.9°W USAF recon	95 9/25/73 Satellite	955 mb 19.6°N, 109.1°W USAF recon	Lower California Peninsula near La Paz	Communication and powerline damage. MARIKA M. steering damaged.
Tropical storm Jennifer	September 23-27	13.0, 116.0	23.1, 106.5	30 15.7°N, 109.3°W SANDVAAG	35 9/24/73 Satellite	1007 mb 115.7°N, 109.3°W SANDVAAG	Coastal area near Mazatlan	None
Hurricane Katherine	September 29-October 8	11.5, 109.8	13.5, 148.0	40 14.0°N, 114.8°W USAF recon	85 9/30/73 Satellite	978 mb 14.0°N, 114.8°W USAF recon	None	None
Hurricane Lillian	October 4-9	11.0, 102.0	17.0, 119.0	80 17.4°N, 117.3°W USAF recon	70 10/7/73 Satellite	990 mb 17.4°N, 117.3°W USAF recon	None	None

sea-level pressure was measured. This is about 100 mb lower than the ambient pressure 180 mi from the center of the storm.

Reports from ships were valuable, for they provided on-the-spot observations used to locate storms. If a lack of weather reports is an indication, no vessels were seriously affected by tropical cyclone activity, although two ships reported steering problems. A maximum wind of 52 kt was reported by the CORNELIA, when she lost her rudder in Doreen. Unlike earlier years, when marked course changes by ships were observed, the storms apparently bypassed shipping areas and little evasive action was noticed in ship movements, despite the severity of three of the hurricanes.

Some powerlines and communication lines were damaged as Irah passed over the southern tip of Baja California during the day and night of September 25. No other reports of damage have been received, but newspaper reports alluded to heavy rainfall and local flooding at most points on the West Coast from 90°W to 110°W several times during the season. The strongest wind reported by a surface vessel was 54 kt from the TEXAN in Heather, but few ships reported near any storm.

A series of daily satellite pictures (figs. 9, 10, 12-14) are shown for five of the seven hurricanes (Ava, Doreen, Emily, Irah, and Katherine). These were prepared by Vernon F. Dvorak of the National Environmental Satellite Service. The code below each picture describes the disturbance and its development at that time according to a technique he developed. This technique is described in NOAA Technical Memorandum NESS 45, February 1973, titled "A Technique for the Analysis and Forecasting of Tropical Cyclone Intensities from Satellite Pictures." The "T" is for tropical, and the numbers and letter describe the storm, its intensity, and change.

A summary of eastern North Pacific tropical storms and hurricanes is included in table 5 and storm tracks are shown in figures 7 and 8.

HURRICANE AVA, JUNE 1 TO 12

This was the first tropical cyclone in the North Pacific this year, and she was a beauty. Hurricane Ava was one of the most vigorous and sophisticatedly measured storms on record in the eastern North Pacific. She started as a depression on June 1, near 11.4°N, 94.5°W, about 250 mi south of Salina Cruz, Mexico. The depression was nearly stationary in its formative stage, but began moving slowly westward after becoming a tropical storm at 1800 on the 2d. Ava was located by satellite and ship reports from the HOEGH TROTTER, JOSEPH LYKES, and the VOLNAY. The reports indicated the presence of a cyclonic circulation, 30-kt winds, and a pressure of 1000.6 mb about 100 mi from the center. Slow westward movement continued with intensification.

The storm became a hurricane by the afternoon of the 3d, when Air Force reconnaissance from Puerto Rico measured winds of 70 kt, with gusts to 95 kt near the center, at 12.6°N, 96.6°W, about 180 mi south of Port Angeles, Mexico. Winds reached 100 kt on the afternoon of the 5th; on the 6th, 137 kt were measured by NOAA aircraft; and Air Force radiosonde equip-

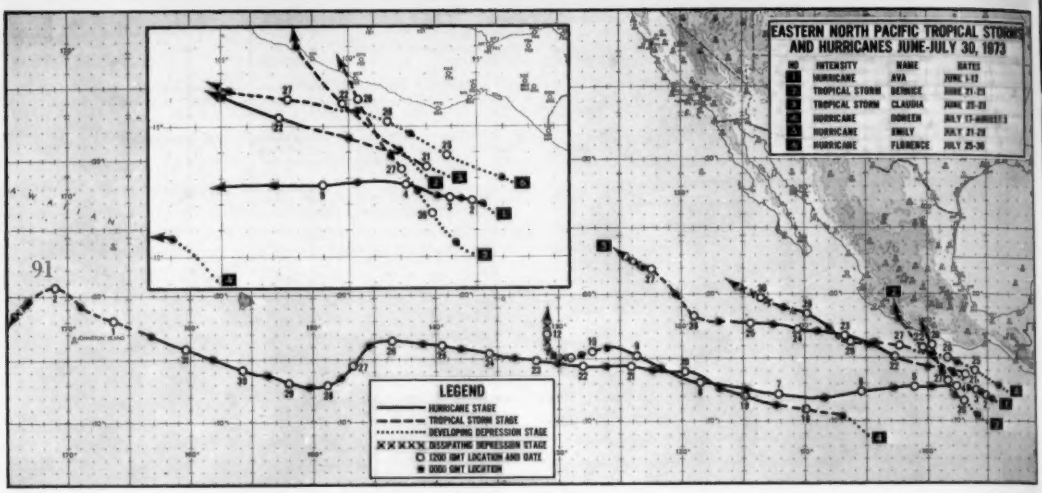
EASTERN NORTH PACIFIC TROPICAL STORMS AND HURRICANES JUNE-JULY 30, 1973
NO INTENSITY NAME DATES
1 HURRICANE AVA JUNE 1-12
2 TROPICAL STORM BERNICE JUNE 21-23
3 TROPICAL STORM CLAUDIA JUNE 25-28
4 HURRICANE DOREEN JULY 13-AUGUST 1
5 HURRICANE EMILY JULY 21-28
6 HURRICANE FLORENCE JULY 25-30
LEGEND
HURRICANE STAGE
TROPICAL STORM STAGE
DEVELOPING DEPRESSION STAGE
DISSIPATING DEPRESSION STAGE
1200 GMT LOCATION AND DATE
0000 GMT LOCATION

Figure 7.--Tracks of eastern North Pacific tropical storms and hurricanes, June-July 30, 1973.

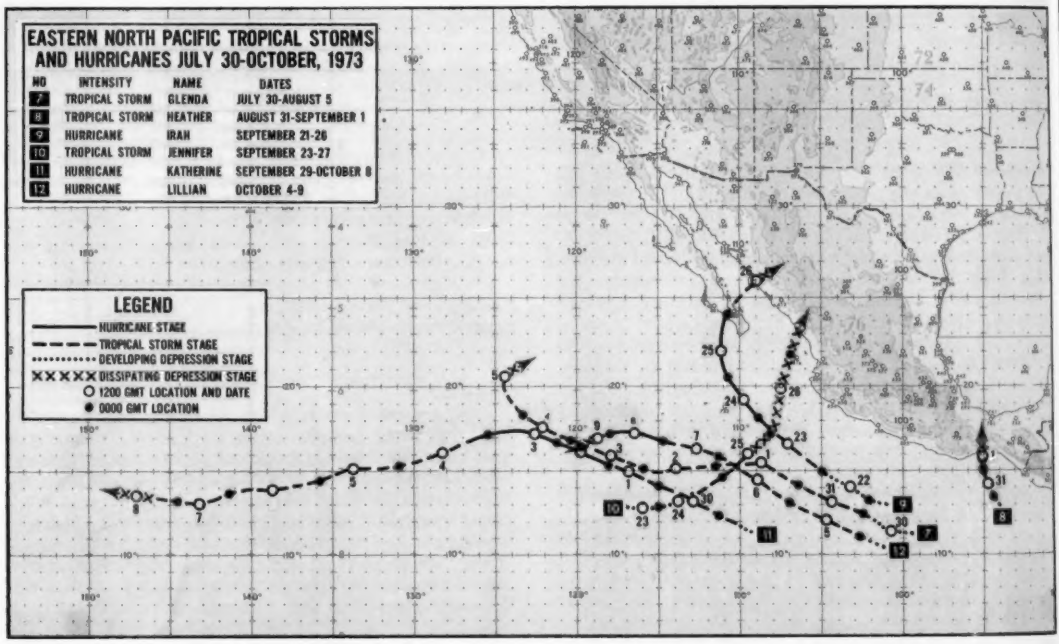
EASTERN NORTH PACIFIC TROPICAL STORMS AND HURRICANES JULY 30-OCTOBER, 1973
NO INTENSITY NAME DATES
7 TROPICAL STORM GLENDA JULY 30-AUGUST 5
8 TROPICAL STORM HEATHER AUGUST 31-SEPTEMBER 1
9 HURRICANE IRAH SEPTEMBER 21-26
10 TROPICAL STORM JENNIFER SEPTEMBER 23-27
11 HURRICANE KATHERINE SEPTEMBER 29-OCTOBER 8
12 HURRICANE LILLIAN OCTOBER 4-9
LEGEND
HURRICANE STAGE
TROPICAL STORM STAGE
DEVELOPING DEPRESSION STAGE
DISSIPATING DEPRESSION STAGE
1200 GMT LOCATION AND DATE
0000 GMT LOCATION

Figure 8.--Tracks of eastern North Pacific tropical storms and hurricanes, July 30-October, 1973.

ment, dropped into the eye, determined a central pressure of 915 mb (27.02 in), 650 mi southwest of Acapulco. At this time, the westward movement had increased to 17 kt.

Skylab passed near hurricane Ava, and the storm was almost directly under satellite NOAA-2 at its peak intensity. Skylab and NOAA aircraft investigating the storm were both equipped with unique sensing devices which enabled them to measure sea heights of 40 ft by radiometric means, the first hurricane wave height measurement by remote sensors. The NOAA aircraft measurements also indicated how rapidly winds increased toward the eye of the storm. In 1 min, 50 sec--4 mi flight distance--winds increased from 60 to 137 kt, and in only 37 sec--a flight distance of 2 mi--winds increased from 90 to

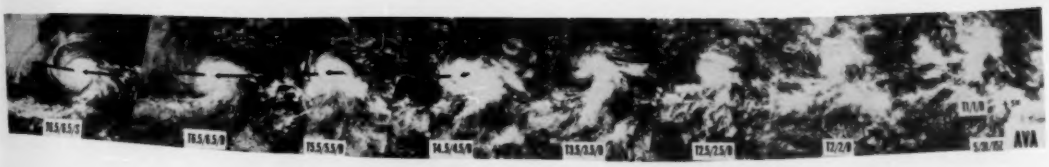

Figure 9.--Daily satellite pictures of Ava (9 a.m. local time), positioned from right to left, commencing on May 31, 1973. Arrows indicate direction of movement.

137 kt. A circular closed-wall eye was observed by the Air Force reconnaissance crew and by the NOAA-2 satellite.

The peak intensity of the hurricane was reached on the 6th, near 11.9°N, 107.5°W, and gradual deterioration continued for the next 6 days. On the 7th, a wind of 120 kt; on the 8th, 100 kt; and on the 9th, 90 kt were measured by reconnaissance. The hurricane weakened to a 60-kt tropical storm near 16°N, 126°W, late on the 9th; to 40 kt on the 10th; and became a depression on the 11th. By the 12th, the remains entered the trades as an easterly wave.

Vessels whose observations aided in locating and tracking the storm were: ACAVUS, AKIBASAN MARU, ANDORA, ASHKHABAD, ATENAS, CHEVRON AMSTERDAM, CHEVRON NAPLES, CLARA MAERSK, DELTARECHT, ERISKAY, HERMAN SCHULTE, HOEGH TROTTER, HOLTEFJELL, JOSEPH LYKES, H. R. MACMILLAN, MORNING LIGHT, OAKLAND, SAN MARIN MARU, SEATTLE, SHEAF TYNE, and the WILKAWA. Others not in the AMVER listings included DAGB, DNCT, GAZG, GZSB, JDNQ, JXJT, KFGX, NKFN, and OWIE.

TROPICAL STORM BERNICE, JUNE 21 TO 23

Tropical storm Bernice was first suggested by satellite pictures and ship reports on the 18th, 300 mi south of Ixtepec, Mexico, as a disturbance on the intertropical convergence zone. The disturbed area remained nearly stationary and increased in intensity until becoming a tropical depression at 1800 on the 21st, near 13°N, 97°W, about 180 mi southwest of Salina Cruz. Movement was toward the northwest at 10 to 12 kt.

Development to tropical storm intensity continued during the afternoon, and, by 0000 on the 22d, winds to 40 kt were estimated from satellite pictures, and a 35-kt wind was reported by the HENNITES. Movement continued northwest, with the TARONGA reporting 40-kt winds about 60 mi from the center, at 1200 on the 22d, and Acapulco, 90 mi from the center, indicating 30-kt winds. At 1800, the TARONGA reported 50-kt winds about 30 mi northwest of the center, while another vessel reported a west 40-kt wind about 50 mi southwest of Zihuantaneo, Mexico, suggesting the storm was moving onshore.

Other vessels whose observations helped locate and track the storm were: the EXPORT CHAMPION, LUDWIGSHAFEN, NORMASCAN, SANTA MARIANA, and the STAR HALMANGER. Others were somewhat remote from the center.

TROPICAL STORM CLAUDIA, JUNE 25 TO 28

Tropical storm Claudia began as a disturbed area noticed on satellite pictures on the 23d, about 300 mi south of San Salvador, near 8°N, 88°W. The area moved westward at about 10 kt to 9°N, 92°W on the 24th. A closed circulation was indicated in satellite pictures, and reports by the SEUCIA, TRENTON, and the STARSTONE centered a weak depression at 10°N, 95°W, by 1800 on the 25th.

Satellite pictures indicated a more northwesterly course between the 25th and 26th, and the depression intensified to a tropical storm with 50-kt winds, near 13°N, 98°W, at 1800 on the 27th. The storm continued north-northwest, but slowed to about 5 kt with maximum winds of 55 kt, until it went onshore about 30 mi east of Acapulco, late on the 28th.

AMVER-listed vessels aiding in locating, tracking, and estimating the intensity of Claudia were: AMERICAN LEGACY, LEMONCORE, MAURICEIN, PACIFIC ERA, SHEAF CREST, STAR COLUMBIA, STARSTONE, SUECIA, TRENTON, UNION SUNRISE, and the ZIM HAFIA.

HURRICANE DOREEN, JULY 17 TO AUGUST 3

Hurricane Doreen began as a disturbed area near 9°N, 101°W, over the warm water off Panama, and was first seen by satellite, at 1600 on July 16. The area was in the intertropical convergence zone and showed some signs of a closed circulation. A nighttime infrared photograph, at 0400 on the 17th, showed the area was moving west at 10 kt and becoming organized. By 1800, satellite pictures placed the center of circulation near 9°N, 105°W, but reports from the KAPAA, HOEGH DYKE, and the AKADEMIC KOROLYOV indicated that the center was some 2° farther north. By this time, a tropical depression had formed, and bulletins were issued.

Development was rapid, with the AKADEMIC KOROLYOV reporting 30-kt winds at 0000 on the 18th, suggesting that a tropical storm had formed near 10.5°N, 107°W, about 120 mi east of Clipperton Island. The AMERICAN CORSAIR reported 38-kt winds and 15-ft seas at 0600, and 0600 and 0900 observations were received from the SHAMALY. An Air Force reconnaissance aircraft measured 60-kt winds at 2230 on the 18th, and at the rate of development taking place, the storm was indicated as a hurricane at 0000 on the 19th.

The hurricane was moving west-northwestward at about 12 kt. The AMERICAN CHALLENGER passed to the south during the night of the 18th. The HOEGH

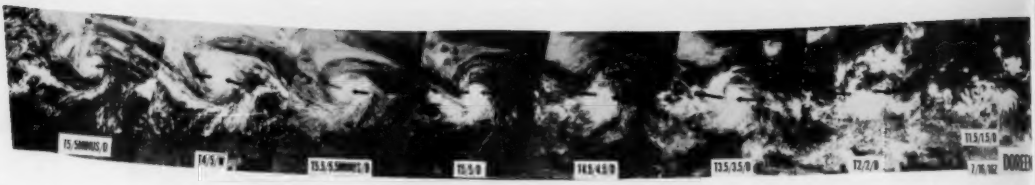

Figure 10.--Daily satellite pictures of Doreen (9 a. m. local time), positioned from right to left, commencing on July 16, 1973. Arrows indicate direction of movement.

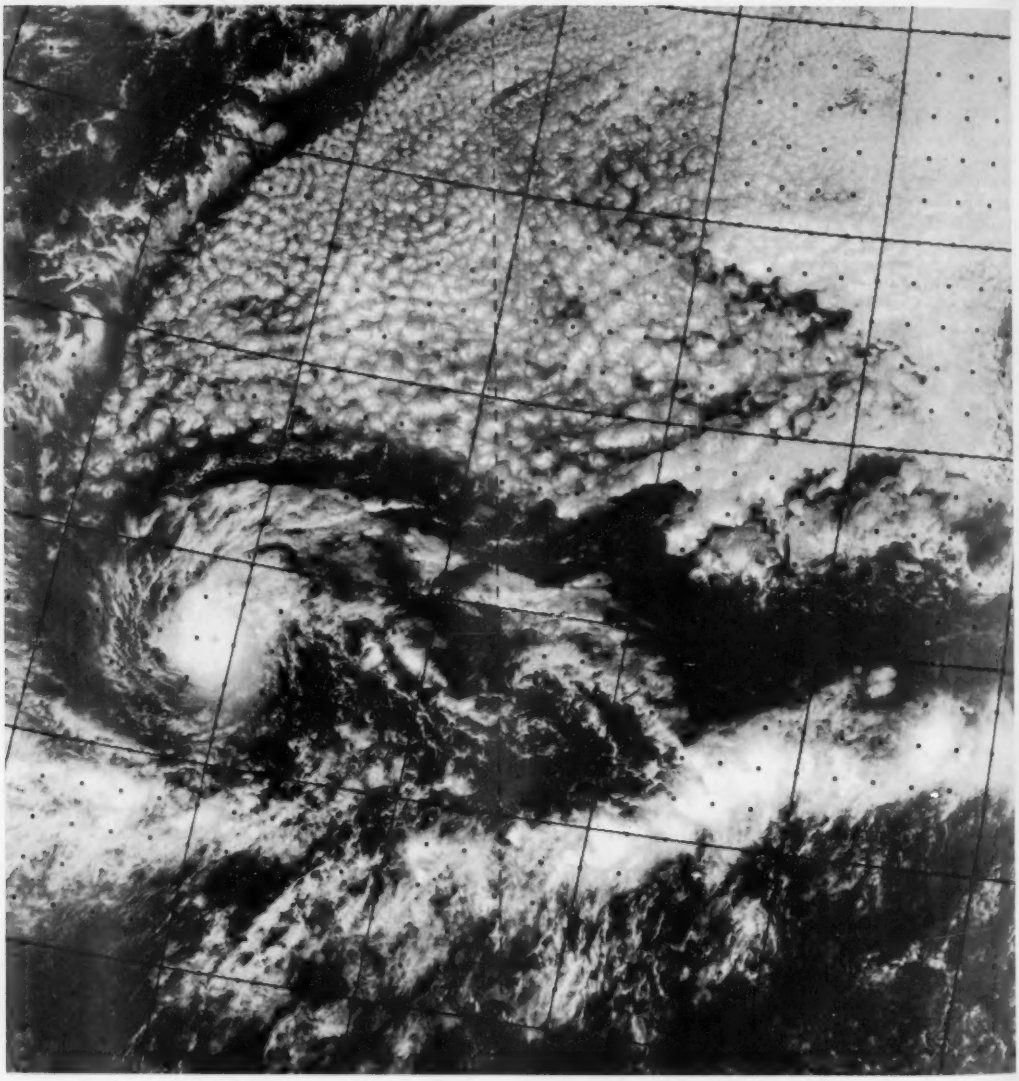

Figure 11.--This DAAP satellite shot pictures the intricate detail of Doreen's cloud patterns after the storm regenerated hurricane winds on July 28, 1973. The center is located near 13°N, 150°W.

DYKE, heading west, passed in front of the storm between 1800 and 2100 on the 19th, reporting 40-kt winds. The SPEY BRIDGE also reported 40-kt winds. Both vessels were about 150 mi from the center. Reconnaissance aircraft at that time measured winds of 90 kt, with a central pressure of 973 mb.

Doreen continued on her course, well out of range of surface vessels. Aircraft reported maximum intensity winds of 120 kt at 1920 on the 20th; 80 kt at 1906 on the 21st; 65 kt at 1825 on the 22d; and 60 kt at 1800 on the 23d, near 15°N, 133°W. Reconnaissance priority after the 23d was directed toward hurricane Emily, nearer to the more heavily traveled shipping lanes of Manzanillo.

Wind speeds in the storm were in the 55- to 70-kt range after 1800 on the 23d. Doreen passed 16.3°N, 140°W, on a westerly course, shortly before 1800 on the 25th.

A frontal system between two portions of the North Pacific high-pressure area weakened as Doreen approached 145°W, and the two cells merged with the main center about 1,000 mi northwest of Honolulu. The main High center moved eastward, forcing Doreen southward on the 27th, to near 12.5°N, 150°W at 1800 on the 28th, after which she set a west-northwesterly course, at 8 to 10 kt.

On the afternoon of the 27th, the 144-ft Greek ship CORNELIA sailed into the storm's path and sent out an emergency call for help when it lost its rudder, while being lashed by 52-kt winds and 35-ft waves. A sea-level pressure of 971 mb was reported. The ship managed to clear the storm and continued its way to Panama, after deciding not to return to Honolulu with Coast Guard assistance.

Before the dip to more southern latitudes, Doreen was classed as a tropical storm, but regeneration developed hurricane winds again (fig. 11) on the 28th, which continued until 0600 on August 1. The hurricane passed 300 mi south-southwest of South Point, Hawaii, on the afternoon of the 30th. On the afternoon of the 29th, 9-ft ocean swells and 3 1/2-ft surf generated by Doreen were observed at Kapoho, the easternmost point of the island of Hawaii.

West of 165°W, deterioration of the storm was rapid. Winds decreased to 60 kt near 18°N, 166°W, at 1200 on August 1; and to 35 kt at 20°N, 171°W, at 1200 on the 2d. At 0000 on the 3d, the storm was a depression with 30-kt winds. Advisories were discontinued, and she dissipated in an upper air trough as she crossed the Dateline.

Doreen was an interesting storm. The sharp recurvature on the 27th and 28th, and the subsequent redevelopment to hurricane intensity, were unusual. She had a long life--18 days, covering a distance of 4,200 mi. She was well behaved--except for the redevelopment period on the 27th, she followed the forecast track. Throughout her life cycle, Doreen followed a strikingly similar path to that of hurricane Celeste in August 1972.

HURRICANE EMILY, JULY 21 TO 28

Squally weather and 40-kt winds in the Gulf of Tehuantepec, beginning July 18, were reported by the ROSEVILLE. The RUTH LYKES reported 30-kt winds. The squalls gradually organized into a cyclonic circulation and formed a tropical depression near 13°N, 96°W, at 0600 on July 21.

The squally area was nearly stationary; but, as it organized, it began moving west-northwestward at 12 kt, becoming tropical storm Emily near 14°N, 99°W, at 1800 on the 21st. Winds increased to hurricane force by 0600 on the 22d. Winds of 40 kt were reported 120 mi from the center by the EXPORT COMMERCE, the TAIAN, and the VAR, and 45-kt by the KEYTANKER, at 0600 on the 22d. At 0300, the EXPORT COMMERCE had encountered 45-kt gales.

Emily ran west-northwestward, nearly parallel to the coast and 180 mi offshore, until south of Manzanillo, where she turned to a more westerly course, leaving the heavily traveled shipping lanes. She developed 110-kt winds at 1755 on the 22d, near 16°N, 104°W, and 90-kt winds at 17°N, 108°W, on the 23d, as measured by Air Force reconnaissance planes. Gale winds were reported off the coast of Mexico, more than 300 mi to the east, between the 22d and 24th. These reports came from the ANTARCTIC CORE, EXPORT COMMERCE, HOEGH MARLIN, POMONA, TAEPING, TAIAN, and the VAR, and non-AMVER-listed vessels GLBF, ICKN, SYWG, and 4XMY. Satellite pictures indicated that Emily maintained hurricane intensity through 1200 on the 25th, then near 17.5°N, 114.5°W.

Gradual weakening then took place, with the tropical storm curving toward the northwest, until winds reached 35 kt. This strength was maintained for about 36 hr, until the center reached 22°N, 123°W, at 0000 on the 28th. Thereafter, remains of the storm were indicated in satellite pictures, and the cloudiness moved northwestward to 25°N, 125°W by August 6, before being absorbed into the northeast trades.

HURRICANE FLORENCE, JULY 25 TO 30

A disturbed area, 150 mi off Guatemala on the 25th, was moving slowly west-northwestward, curving a little toward the coast. The area was slow to develop;

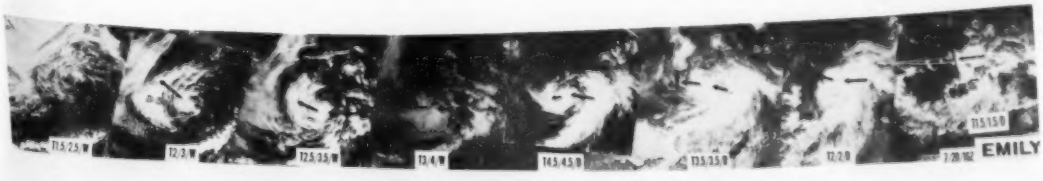

Figure 12.--Daily satellite pictures of Emily (9 a.m. local time), positioned from right to left, commencing on July 20, 1973. Arrows indicate direction of movement.

but, at 0600 on the 26th, the LABRADOR CLIPPER and the UNION EAST reported 30- and 35-kt winds, respectively, and indicated a cyclonic circulation about 75 mi southeast of Acapulco.

By 0000 on the 27th, reports from the ARCO COLUMBIA, GOTAMA JAYANTI, SHIRLEY LYKES, and VARICELLA indicated that the greatest activity had moved to about 100 mi south of Acapulco, with a circulation strong enough to indicate a tropical storm. A westward movement continued, as the storm slowly increased, becoming hurricane Florence.

The hurricane continued west-northwestward until 2150 on the 28th, when winds reached an estimated 80 kt, according to satellite pictures. A pressure of 990 mb was measured by reconnaissance aircraft. As the storm moved over cooler waters and into more stable air from the north, dissipation was completed in less than 24 hr, near 20.5°N, 115.5°W, by 1800 on the 30th.

TROPICAL STORM GLENDA, JULY 30 TO AUGUST 5

Glenda developed slowly, about 300 mi off the coast of Guatemala. As a tropical disturbance, she moved west at about 12 kt, until south of Acapulco, when a closed circulation was inferred from nighttime satellite pictures, at about 0400, July 30.

At 1800 on the 30th, the MALLORY LYKES reported squalls and southerly 30-kt winds about 75 mi east of the center, and the NISSAN MARU, a north wind of 10 kt, 180 mi west of the center. An advisory was issued for a tropical storm, with winds to 40 kt, heading west-northwestward at 12 kt.

This direction of movement and speed continued through the 4th. Winds increased to 50 kt during the night of the 31st, then appeared to decrease to the 30-kt winds of a tropical depression, at 1800 on the 1st. The available data indicated the storm was maintaining 30-kt winds through 1200 on the 4th, near 18°N, 123°W. However, the TOYOTA MARU reported 40-kt winds, with a 989.3-mb pressure, at 1800, indicating that a tropical storm was still in progress. This intensity was continued until 1800 on the 5th, when satellite pictures showed cool air entering the dissipating system. Later data and analysis verified that Glenda remained at or above tropical storm strength between the 1st and 4th.

Few ships reported weather in the vicinity of Glenda, through most of her life. Positions were largely based on visual and infrared satellite pictures, at about 1800 and 0500, respectively.

A correlation of eastern North Pacific storm intensity with satellite pictures is a continuing program that can only be successful if vessels experiencing storm conditions send weather reports to "METEO WASHDC." Use the preferred format, preceded by the word "STORM."

TROPICAL STORM HEATHER, AUGUST 31 TO SEPTEMBER 1

A tropical depression developed into tropical storm Heather at 1800 on the 31st, after a period of development starting on the 29th.

The convergence zone was active along 8°N, 82°W to 10°N, 92°W. At 0000 on the 30th, a large cloud mass, on satellite pictures near 13°N, 94°W, indicated that a disturbance had formed. The AMERICAN LIBERTY and the UNDEN reported pressures of about 1007 mb, and a cyclonic circulation near 13°N, 93°W was indicated.

No further reports were received until 1800 on the 30th, when the disturbance became a depression with a central pressure of 1004 mb, centered near 13.4°N, 94°W. The AMERICAN AQUARIUS, CHRYSALEMA, and the DAISHIN MARU were in the peripheral area.

The depression developed into a tropical storm after moving northwest to 15°N, 95°W, at 1800 on the 31st. At 0000 that day, the BOSTON had reported 40-kt southwesterly winds at 13°N, 93°W. The TEXAN reported 30-kt winds about 30 mi southeast of the center and, at 2100, found 54-kt winds, with 26-ft swells, at 15.4°N, 95.6°W.

At 1800 September 1, Heather was relocated near 15.5°N, 98°W, farther west than previous movement would have indicated. Reports from the CLARK-MAXWELL and the PEMEX C indicated a weak circulation and low-pressure center, but these were later analyzed to be associated with a different short-lived small-scale system. Heather died during the morning of September 1, near 15.5°N, 95°W.

HURRICANE IRAH, SEPTEMBER 21 TO 26

Hurricane Irah began as a tropical disturbance near 13°N, 97°W, at 1800 on the 20th. Showers and squalls were reported the previous day, and the NANCY LYKES estimated 35-kt winds several degrees north of the center of a large mass of clouds. Westward movement of about 10 kt was indicated by ship reports and satellite pictures, as the disturbance became more organized.

Tropical depression stage was reached by 1800 on the 21st, near 13°N, 101°W, with the center turning northwestward. Tropical storm intensity was attained by 0000 on the 23d, at 15°N, 104.5°W. Ships reporting near the developing system included the MAGELLAN MARU, MARCONFIELD MERCHANT, MEGUROSAN

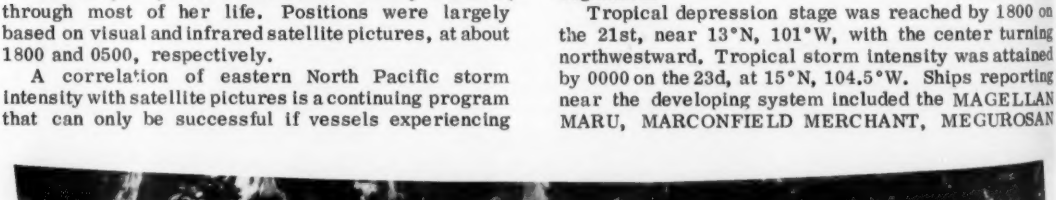

Figure 13.--Daily satellite pictures of Irah (9 a.m. local time), positioned from right to left, commencing on September 20, 1973. Arrows indicate direction of movement.

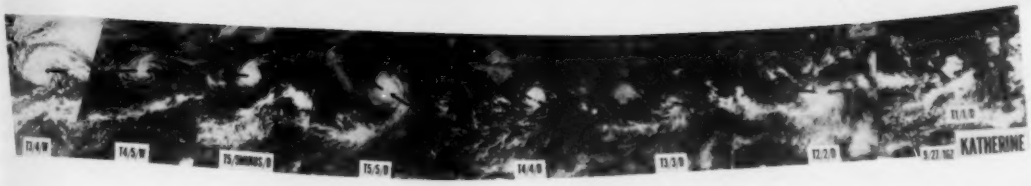

Figure 14.--Daily satellite pictures of Katherine (9 a.m. local time), positioned from right to left, commencing on September 27, 1973. Arrows indicate direction of movement.

MARU, TUGELA, and a non-AMVER-listed vessel, URPH. Movement continued northwestward at 12 to 15 kt, but slowed to about 8 kt as it intensified to hurricane strength at 1800 on the 23d, with the HOEGH MALLARD, NAGARA MARU, OAKLAND, and the TUGELA reporting from points well away from the center.

A more northerly course was taken from the 24th to the 26th, with winds increasing to 95 kt at 0600 on the 25th, after which weakening began. The Cypriot motorvessel MARIKA M., Los Angeles to Santos, had to proceed to the Mexican coast on manual steering after sustaining damage.

The hurricane moved across the Baja California Peninsula during the afternoon of the 25th, with 65- to 70-kt winds and heavy rain causing some power and communication line damage at La Paz. Further weakening took place during the night of the 25th, as the hurricane became a tropical storm, by 0600 on the 26th, with estimated 50-kt winds. By the time the storm moved onshore, about 30 mi northwest of Los Mochis, at 1600 on the 26th, it had weakened to 35-kt winds, with only light rainfall.

TROPICAL STORM JENNIFER, SEPTEMBER 23 TO 27

Tropical storm Jennifer began developing as a tropical depression near 13°N, 116°W, at 1200 September 23. The depression drifted eastward, south of hurricane Irah, and slowly intensified until it became a tropical storm with 35-kt winds, near 13°N, 113°W, at 1800 on the 24th. No surface vessels were near the system, so its location and intensity were estimated from satellite pictures. Afternoon pictures indicated weakening and the storm intensity was lowered to depression stage, moving northwestward at 10 kt.

At 1200 on the 25th, the SANDVAAG reported a 1007-mb pressure and a 30-kt wind, about 40 mi from the center. This report was not available at map analysis time and suggested the tropical storm warnings should have been continued. At 1800, the TOYOTA MARU No. 18 and the non-AMVER-listed vessel 6MJJ located the center near 16.5°N, 109°W, moving northeastward at 10 kt. Reports at 0000 on the 26th from the HOEGH TRADER and the STATE OF MADYA PRADESH indicated the storm intensity had lowered to a tropical depression.

Local heavy squalls continued moving northeastward at 10 to 12 kt, brushing the Tres Marias Islands and moving onshore just southwest of Mazatlan, as indicated by reports from the BOSTON MARU, MARIAE LISA, and the USCGC NORTHWIND, at 0600 on the 27th.

HURRICANE KATHERINE, SEPTEMBER 29 TO OCTOBER 8

Squally areas of showers and thunderstorms developed about 400 mi south of Zihuantenejo on September 27, drifted westward and increased in activity on the 28th, and showed cyclonic circulation just north of Clipperton Island by the morning of the 29th. Satellite pictures at 1800 suggested intensification had continued, with development into tropical storm Katherine. The MOUNT PARK, southeast bound, north of the center, experienced 10- to 20-kt veering winds.

The storm moved northwestward at 12 to 15 kt, as it was followed in successive satellite pictures, due to a lack of ship reports near the storm. The SHEAF TYNE's reports on September 30 and October 1 indicated the presence of the storm, while 200 to 300 mi south of the center.

Infrared pictures at 0435 October 1 showed a well-developed hurricane near 14°N, 116.5°W. The hurricane reached a maximum intensity of 85 kt near 16°N, 118°W, at 0000 on the 2d, and continued that strength to near 17°N, 121°W, at 0000 on the 3d. Weakening began as the storm continued moving westward at 15 kt, becoming a tropical storm near 17°N, 127°W, at 0600 on the 4th.

The storm then moved west-southwestward at 10 to 12 kt, to 14°N, 140°W, when it was transferred to the Central Pacific Hurricane Center at Honolulu, at 1800 on the 6th.

The storm moved westward at 12 kt with winds of 40 to 50 kt through the 7th, weakening to 35 kt during the night of the 7th, and to a depression with 30-kt winds on the 8th. It dissipated near 14°N, 148°W, soon after 1800 on the 8th.

Vessels reporting from the periphery of the cyclone included the EXPORT BANKER, PIONEER, CONTENDER, TAKUYO MARU, and non-AMVER-listed vessels BLHD, FNAW, GLHF, and UNDK.

HURRICANE LILLIAN, OCTOBER 4 TO 9

A large area of thunderstorms was followed on satellite pictures from about 300 mi south of the Gulf of Tehuantepec, on October 2, to 400 mi south of Manzanillo, at 0000 on the 5th. Reporting ships were generally 200 to 300 mi from the center, at the closest, but the KAPAA and the SANTA MARIANA helped locate the disturbance, which was to become hurricane Lillian.

Gradual intensification took place, and satellite pictures, at 0330 on the 5th, indicated a tropical storm had developed near 11°N, 103°W. The storm was moving northwestward at 10 kt, a direction and speed that was maintained through 1800 on the 7th. At 0000 on the 5th, the storm passed about 120 mi south of the UNION VENUS, which reported 30-kt winds.

Few ships reported near the storm, but, at 1800 on the 7th, the characteristic cloud formation of a hurricane was visible in pictures. A more westerly course was followed after intensification occurred, but, as the hurricane moved over cooler waters southwest of the Lower California peninsula, dissipation was rapid. At 0000 on the 9th, it was a hurricane with 70 kt winds; by 0600, a tropical storm of 50 kt; by 1200, 45 kt; and, at 1800, only a swirl of clouds remained.

THE TSUNAMI WARNING SYSTEM

Mark G. Spaeth
National Weather Service, NOAA
Washington, D.C.

On Good Friday afternoon, March 27, 1964, the Alaska Steamship Company vessel CHENA, a 10,815-ton cargo ship, approached the Alaska town of Valdez, docking at 4:12 p.m. (0212/28 GMT). By 5:30 (0330/28), the CHENA was busily off-loading cargo, unaware of the impending disaster threatening the ship and those working her. Here is the story as recorded by her master, Captain M. D. Stewart.

"The CHENA arrived at Valdez at 0212, March 28. About 0331, while discharging cargo, we felt a severe earthquake--followed almost immediately by tidal waves. There were very heavy shocks about every half a minute. Mounds of water were hitting us from all directions. I was in the dining room. I made it to the bridge (three decks up) by climbing a vertical ladder. God knows how I got there.

"The Valdez piers started to collapse right away. There was a tremendous noise. The ship was laying over to port. I had been in earthquakes before, but I knew right away that this was the worst one yet. The CHENA raised about 30 ft on an oncoming wave, and the whole ship lifted and heeled to port about 50°. Then it was slammed down heavily on the spot where the docks had disintegrated moments before. I saw people running, with no place to run. It was ghastly. They were engulfed by buildings, water, mud, and everything. The CHENA dropped where the people had been--there was no sight of them. That was what kept me awake for days. The ship stayed there momentarily. There was an ungodly backroll to starboard, then she came upright. We took another heavy roll to port.

"I could see the land (at Valdez) jumping and leaping in the terrible turmoil. We were now inside of where the dock had been. We had been washed into where the small boat harbor used to be. There was no water under the ship for a brief interval. I realized we had to get out quickly if we were ever going to get out at all. There was water under us again. The stern was sitting in broken piling, rocks, and mud.

"I signaled to the engineroom for power and got it very rapidly. I called for 'slow ahead,' then 'half ahead,' and finally for 'full.' In about 4 min, I would guess, we were moving appreciably, scraping on and off the mud bottom as the waves went up and down. People ashore said they saw us slide sideways off a

Figure 15.--The commercial dock facilities at Seward, Alaska, were badly damaged and are partially under water. U.S. Army Photo.

Figure 16.--Aftermath of the March 1964 tsunami near Seward, Alaska. A boat and an aid to navigation buoy have been washed ashore.

net of willow trees that had been placed as part of the fill material in the harbor, and that helped put our bow out. We couldn't turn. We were moving along the shore, with the stern in the mud. Big mounds of water came up and flattened out. Water inshore was rushing out. A big gush of water came off the beach, hit the bow, and swung her out about 10°. If that hadn't happened, we would have stayed there with the bow jammed in a mudbank and provided a new dock for the town of Valdez.

"Finally we broke free. The bow pushed through the wreckage of a cannery. We went out into the bay and had to stop because the condensers were plugged with mud and pieces of the dock. We had the lifeboats manned and ready. I didn't think she would float in deep water. The chief mate, Neal L. Larsen, checked to see if we were taking water--we were taking none. It was unbelievable after what the ship had been through. Maybe the soft mud bottom made the difference."

Although the CHENA survived the tsunami, three people on the ship died, two under falling cargo and one from a heart attack. The ship was in the most dangerous possible location to ride out a tsunami--tied to a dock, where incoming waves could batter it against the shore and the trough between could allow it to ground. Throughout history, many ships have been destroyed in this way, caught without warning by a wave which used them as battering rams to destroy not only docks, but warehouses and buildings on the shore (figures 15 and 16). On April 1, 1946, a tsunami struck Hilo Harbor in Hawaii (fig. 17), smashing the waterfront, claiming many lives, and causing millions of dollars of damage.

Tsunamis are long-period waves generated by earthquakes or underwater volcanic explosions. In the deep water of the open ocean, the wave crests may be 100 or more mi apart, and their height from crest to trough may only be a foot or two. They cannot be felt aboard ships in deep water, and they cannot be seen from the air. But a tsunami has an impressive amount of energy. Even in the deepest water, a tsunami is a shallow water wave, which means that the progress of the series of waves involves the movement of the entire vertical section of the ocean, through which the tsunami passes. In the deep ocean, a tsunami may reach speeds of 600 mi per hr (fig. 18).

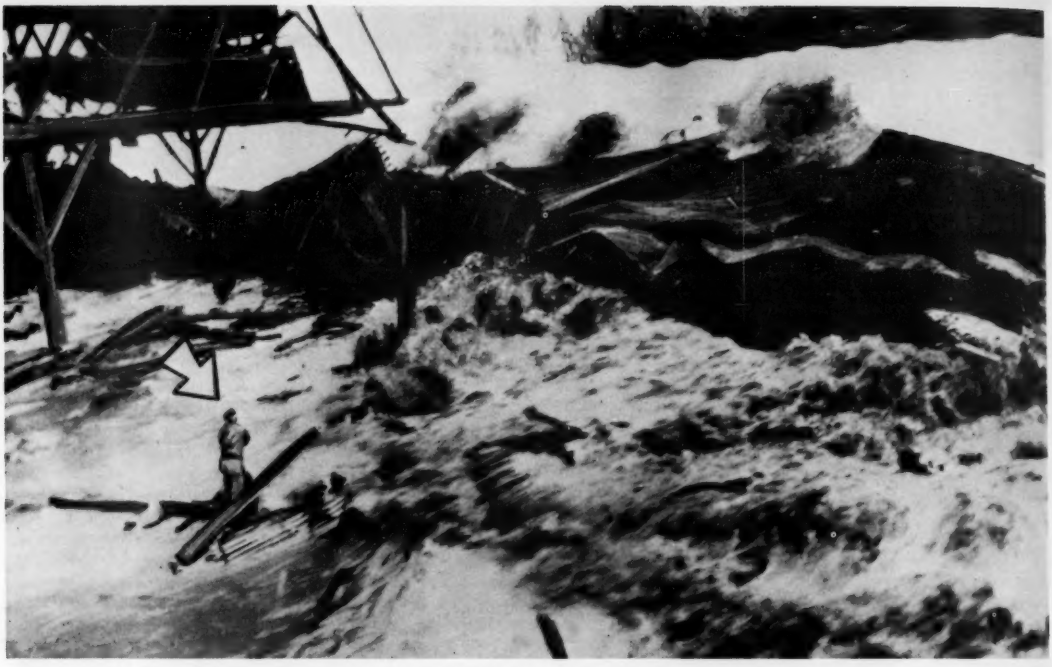

Figure 17.--A huge wave is breaking over Pier No. 1 as a tsunami struck Hilo Harbor, Hawaii, on April 1, 1946. The man in foreground lost his life. The photo was taken from the BRIGHAM VICTORY, at the pier.

When a tsunami reaches the shoaling water of the coast, the velocity of the wave decreases and the energy contained in the wave causes the waves to build up in height, sometimes to more than 100 ft.

Although scientists can compute the time required for a tsunami to travel from one point to another, and thus accurately predict the arrival time of a tsunami generated by a given earthquake, there is much about tsunamis that scientists do not know. For example, there is no way to tell whether an earthquake has generated a tsunami except by actually observing the disturbance. And there is no way to forecast the height of the waves in a tsunami at a given coast. The mechanisms which can cause a tsunami to have a height of 50 ft or more at one place and less than 5 ft only a few mi away are only imperfectly understood.

Since 1948, a system has existed to protect the population of the Pacific from tsunamis generated in distant areas. With advance warning, ships can put out into deep water, where the passing waves of the tsunami are not detectable. People ashore can evacuate coastal areas which may be flooded. The system is called the Tsunami Warning System, and, since September 16, 1973, it has been operated by the National Weather Service, from the Weather Service's Honolulu Observatory.

The Tsunami Warning System is an amalgam of organizations, governmental and private, foreign and domestic, all operating at a high degree of readiness, to detect the infrequent tsunamis which cause death and destruction across the Pacific. The operation of the system begins with the detection of major earthquakes by the cooperating seismograph stations, scattered from La Plata, Argentina, to Hong Kong and from Wellington, New Zealand, to Indian Mountain, Alaska. Data are transmitted over the fastest available circuits to Honolulu, where the location of the earthquake and its magnitude are determined. If the earthquake is large enough and in an area where tsunami generation is possible, Honolulu Observatory requests the participating tide stations closest to the epicenter of the earthquake to examine their records for indications that a tsunami has been generated. If one has, Honolulu Observatory issues a warning to the various governmental organizations which are responsible for relaying the warnings to the population in the endangered areas.

Because it takes a considerable amount of time for the Pacific-wide warning system to react (up to an hour for Honolulu Observatory to collect enough data to locate and determine the magnitude of an earthquake), the National Weather Service operates a regional tsunami warning system in Alaska, with headquarters at Palmer Observatory and a subsidiary warning center at Adak Observatory. Data from a widespread tide and seismic network are continuously telemetered to Palmer Observatory, and Adak Observatory receives data from a local net. Based solely on the location and magnitude of an earthquake, the Alaska Regional Warning System is able to release tsunami warnings to Civil Defense, Coast Guard, military, and other governmental officials within 15 min of the occurrence

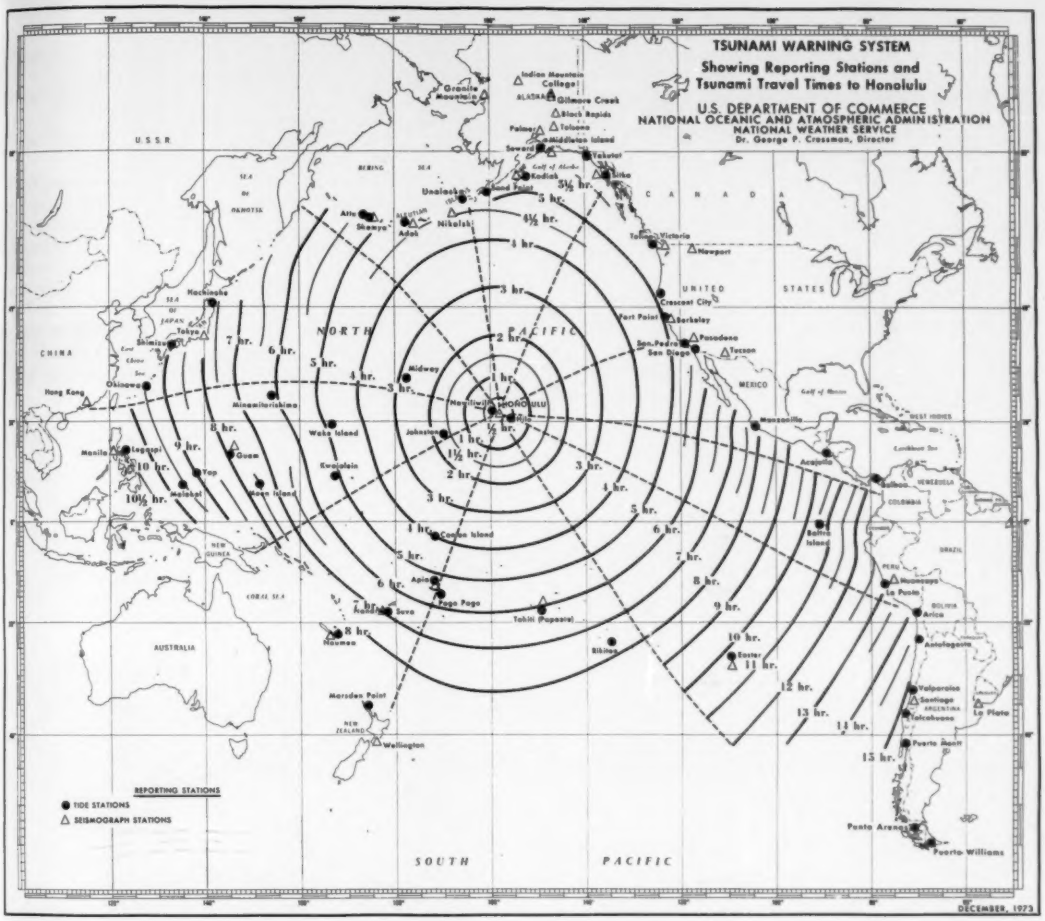

Figure 18.--This chart shows the time it takes for a tsunami to travel to Honolulu from various areas of the Pacific Ocean. The speed of the waves varies with depth; therefore, the time circles enclose various distances.

of an earthquake. Confirmation of the actual existence of a tsunami may or may not be available when the warning is issued.

Tsunami research in NOAA is performed by the Joint Tsunami Research Effort of the Environmental Research Laboratories and the University of Hawaii. Primary research is aimed at providing wave height forecasts for tsunamis.

Ships in harbors should immediately proceed to deep water when a tsunami warning is received. The time element is critical because of the speed of the waves.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

Hints to the Observer

WIND INDICATOR CODE PROBLEM

A serious problem has been noted recently in connection with the "i_w" indicator of the "YYGG i_w" group in the International Ship Weather Code (fig. 19), when reporting ship weather observations. This difficulty has been amplified due to computer processing of the observations.

The problem arises when a "0" (wind estimated in meters per second) is coded instead of a "3" (wind estimated in knots), when the winds are actually reported in knots. The same would also apply with codes "1" and "4," but they aren't used as often. If the wind speed is actually reported in knots, but a code "0" or "1" is used for the "i_w" indicator, the computer, plotter, or analyst would consider the speed to be meters per second, and, to obtain the value in knots for general usage, would approximately double that value and indicate a speed about twice that actually observed.

United States ships and those of many other countries report winds in knots and therefore should use code "3" for estimated winds and code "4" for those equipped with anemometers.

AID NO. 7
WIND INDICATOR

i_w

Code Figure	Type of wind reported	
0	Estimated	METERS PER SECOND
1	Measured by anemometer	
3	Estimated	KNOTS
4	Measured by anemometer	

Note: U. S. Synoptic reports (Ship and Land) use knots - Code figures 3 and 4.

Figure 19.--Aid No. 7 from NOAA Form 72-1, for coding the type of wind reported.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

NEW PUBLICATION WORLDWIDE MARINE WEATHER BROADCASTS

Worldwide Marine Weather Broadcasts, the publication replacing the former Weather Service for Merchant Shipping, has been printed. Hopefully, radio officers of ships enrolled in the weather reporting program have received their copies. Readers who are not radio officers on these ships, but who want to obtain a copy, may purchase one from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; the price is $1.45.

CORRECTIONS TO PUBLICATION WORLDWIDE MARINE WEATHER BROADCASTS

There have been many changes in the booklet since it was compiled, and there are numerous errors to be corrected. In this issue of Mariners Weather Log, we shall focus on the radiotelegraph (CW) and radiofacsimile broadcasts.

Page 9--Boston, Mass. (NMF, NIK, WOU): Amend area (a) to read "North Atlantic waters north of 32°N," etc.

Page 12-Chatham, Mass. (WCC): Amend area affected to read "(a) Offshore waters: 32°N-41°N and west of 65°W (West Central North Atlantic Waters), (b) New York Harbor."

Page 12-Amagansett, N. Y. (WSL): Delete footnotes 2 and 3.

Page 14-Tuckerton, N. J. (WSC): Delete scheduled

broadcasts at 1418 and 2318 GMT.

Page 16-Norfolk, Va. (NAM): Under "Contents," Part 4, delete Ocean Weather Stations A and C.

Page 18-Jacksonville, Fla. (NMV): Delete the A_1 broadcasts on 430 kHz.

Page 19-Ojus (Miami), Fla. (WAX): Delete all details; broadcasts discontinued.

Page 19-Lantana (Miami), Fla. (WOE): Change broadcast times to read "0105, 1305."

Page 22-Port Arthur, Tex. (WPA): Delete the 1748 GMT broadcast. The Station continues to transmit warnings.

Page 55-San Francisco, Calif. (NMC): Revise as follows:

Station: San Francisco, Calif. (NMC)
Area affected: (a) North Pacific, equator-30°N, east of 140°W
(b) North Pacific, north of 30°N, east of 160°E
(c) Offshore waters to 250 mi, Mexican border to Cape Flattery, Wash.
(d) Coastal waters, Pt. St. George, Calif., to Pt. Conception, Calif.

Call sign	Time of broadcast	Frequencies (kHz)	Class of Emission	Power (kw)
NMC	0330, 1700; on receipt[1]	420	A_1	2
	0030, 1900, 2100	8682 12730 17151.2	A_1	5-10
	0630	4346 8682 12730	A_1	5-10
	0430, 1030, 1230	4383.8 8732.1 13147.5	A_3J[2]	5-10
	1630, 2230	8732.1 13147.5 17293.5	A_3J[2]	5-10

Time of broadcast	Type of message	Contents of message
0030	Situation Forecast	Synopsis, forecasts, and warnings for areas a and b.
0330	Forecast	Forecast and warnings for area d.
0430	Situation Forecast	Synopsis, forecasts, and warnings for areas a, b, and c.
0630	Situation Forecast	Synopsis, forecasts, and warnings for areas a and b.
1030, 1230, 1630	Situation Forecast	See 0430
1900	Situation Forecast	See 0630
2100	Situation Forecast	See 0030
2230	Situation Forecast	See 0430
On receipt[1]	Warnings	Gale, storm, hurricane warnings

1 Broadcasts of gale/storm/hurricane warnings are made on 420 kHz at the end of the first silence period following receipt of the message, preceded by announcement on 500 kHz. If this broadcast occurs outside the watch hours of single radio operator ships, the message is repeated at the end of the next silence period falling within the watch hours.

Page 56-San Francisco, Calif. (KPH): Change 22557 kHz to read "22479."

Page 56-San Francisco, Calif. (KFS): Delete 6348 kHz. Delete footnote 3 and the footnote reference following 17184.8 kHz. Renumber the footnotes so that old footnote 4 becomes footnote 3; change 22515[4] to read "22515[3]."

Page 58-Los Angeles, Calif. (KOK): Under "Area affected," change "Pt. Arguello" to read "Pt. Conception."

Page 59-Long Beach, Calif. (NMQ): Under "Area affected," change "Pt. Arguello" to read "Pt. Conception."

Page 67-Manila, Philippines (DZN): Delete 6438 and 8584 kHz.

Page 80-Sydney, Australia (VIX): Change 16918.8 kHz to read 17256.8 kHz.

Page 103-Brentwood, N. Y. (WFH, WFK): Insert under "Schedules": 24-hr surface prognosis/24-hr sea and wind prognosis, heights in meters (Map CA-18) 1039, 2302. Insert under "Map areas, etc.": CA-18: 10°S-45°N and 10°W-100°W.

Page 109-Pretoria (ZRO): Station is listed as Pretoria, South America; change to read "Pretoria, South Africa (ZRO)."

Page 110-San Francisco, Calif. (NMC): Revise as follows:

Service area: Eastern and Central Pacific Ocean
Frequencies: 4344.1 (0000-1829 GMT) 8680.1, 12728.1 (0000-2400 GMT) 17149.3 (1820-2400 GMT)
Transmission speed: 120 scans/minute
Index of cooperation: 576
Schedules: 36-hr surface prognosis (Map B), 36-hr sea & swell prognosis (Map B), surface analysis (Map B), mean wind & weather prognosis (Map A), mean sea & swell prognosis (Map A) 0100, 2300; extended outlook for 72 & 96 hr (Map C), surface analysis (Map B), significant weather prognosis (Map B) 0520, 0700; wind, weather & sea condition (Map A) 1500; surface analysis (Map B), significant weather prognosis (Map B), wind, weather & sea conditions (Map A) 1820; surface analysis (Map B), significant weather prognosis (Map B), wind, weather & sea conditions (Map A), 36-hr surface prognosis (Map B), 36-hr sea & swell prognosis (Map B) 2000.
Map areas: A: 20°S-30°N, east of 160°W
B: North of 30°N, east of 160°E
C: North Atlantic and North Pacific Oceans

Page 111-Honolulu, Hawaii (KVM 70): Delete first note, "Broadcast schedule transmitted at 0000 GMT, etc." Replace with the following footnote:

1 Transmissions are on two frequencies only, depending on radio propagation conditions. For some time to come, the choices are likely to be 11090 and 23331.5 kHz.

COASTAL AND OFFSHORE FORECASTS ALONG THE U.S. ATLANTIC COAST

In December 1973, Tropical Radio WAX, Miami, Fla., discontinued all weather broadcasts. As reported in this column in the January issue, RCA Radio Stations WCC (Chatham, Mass.), WSC (Tuckerton, N.J.), WOE (Lantana, Fla.), and WPA (Port Arthur, Tex.) discontinued transmitting forecasts for coastal waters. Several ship captains and radio officers have commented on the resulting lack of coastal forecasts along the United States Atlantic coast. In answering their letters, it was pointed out that forecasts for offshore waters are available, and these are well suited to the needs of coastwise shipping, since the forecasts cover all waters out several hundred miles, including the coastal strip. On the other hand, the coastal forecasts are primarily for recreational boaters, and the trend is to carry them on the Coast Guard's 2 mHz voice broadcasts.

Users will find the Atlantic offshore forecasts are broadcast by Radio NMF (Boston), WCC (Chatham, Mass.), WSL (Amagansett, N. Y.), WOE (Miami, Fla.), and WLO (Mobile, Ala.). Complete details of these broadcasts can be found in the new publication Worldwide Marine Weather Broadcasts, as corrected above.

CHANGES IN PUBLICATION U. S. AND FOREIGN COASTAL RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATION MESSAGES

Page 6--4YC, Ocean Weather Station C: Delete, station closed.

Page 14-Station HLP, Pusan, South Korea: Change 8742 kHz to read 8473 kHz.

ACKNOWLEDGMENT OF CORRESPONDENCE

The National Weather Service appreciates the information and comment on marine weather services submitted recently by J. R. Parker, Radio Officer, KOREAN MAIL, and Gary Wood, Radio Officer, GUADALUPE. Thanks also to Capt. Arthur Shields, USNS PECOS, for samples of radiofacsimile charts received on his ship.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Hurricane Alley

Richard M. DeAngelis
Environmental Data Service, NOAA
Washington, D.C.

A total of 12 tropical cyclones plied the waters of the Indian Ocean (North and South) and the South Pacific region during November and December (figs. 20 and 21). This is about twice the average. December usually marks the beginning of the Southern Hemisphere's tropical cyclone season and the end of the North Indian Ocean season. However, the activity during these 2 months was comparable to that of midseason.

NORTH INDIAN OCEAN

A December hurricane and two November tropical storms assailed the waters of the Bay of Bengal. All three storms formed between Sumatra and Ceylon, then moved northward and made landfall around the mouths of the Ganges.

The December hurricane reached a peak on the 7th and 8th (fig. 22), when winds near the center were estimated at 70 kt. The JAI AMOTI, close to the center at 1200 on the 8th, reported a pressure of 991 mb, with 50-kt winds in heavy rain. The ORINOCO ran into 40-kt winds 60 mi north of the center, and, later, 35-kt winds some 180 mi to the south. The JALAN was buffeted by 30-kt winds 180 mi northeast of the center. The hurricane weakened as it neared land. On the 9th, it crossed the coast as a tropical storm near Calcutta. The coast of Bangladesh took the brunt of the blow. Some 200 fishing vessels capsized along this coast, with an estimated 1,000

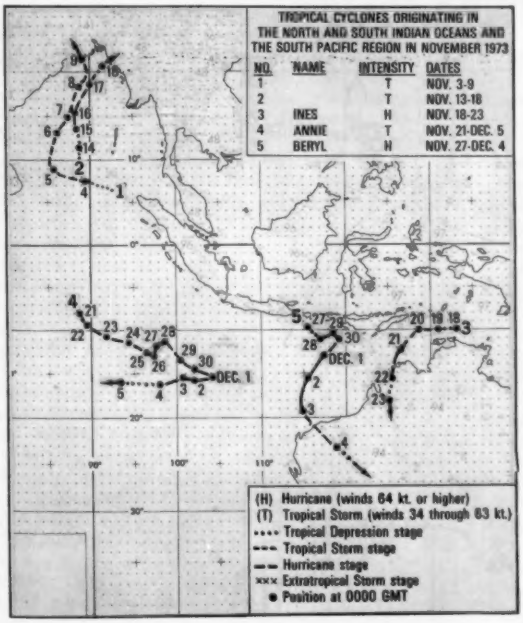
TROPICAL CYCLONES ORIGINATING IN THE NORTH AND SOUTH INDIAN OCEANS AND THE SOUTH PACIFIC REGION IN NOVEMBER 1973
NO. NAME INTENSITY DATES
1 T NOV. 3-9
2 T NOV. 13-18
3 INES H NOV. 18-23
4 ANNIE T NOV. 21-DEC. 5
5 BERYL H NOV. 27-DEC. 4
DEC. 1
(H) Hurricane (winds 64 kt. or higher)
(T) Tropical Storm (winds 34 through 63 kt.)
Tropical Depression stage
Tropical Storm stage
Hurricane stage
Extratropical Storm stage
Position at 0000 GMT

Figure 20.--Tropical cyclones, North and South Indian Ocean, and South Pacific Ocean, November 1973.

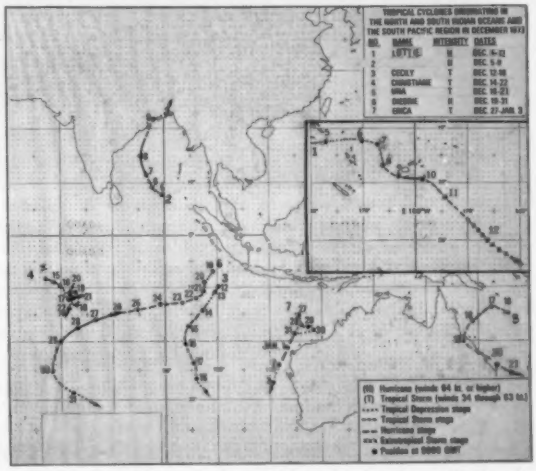

Figure 21.--Tropical cyclones, North and South Indian Ocean, and South Pacific Ocean, December 1973.

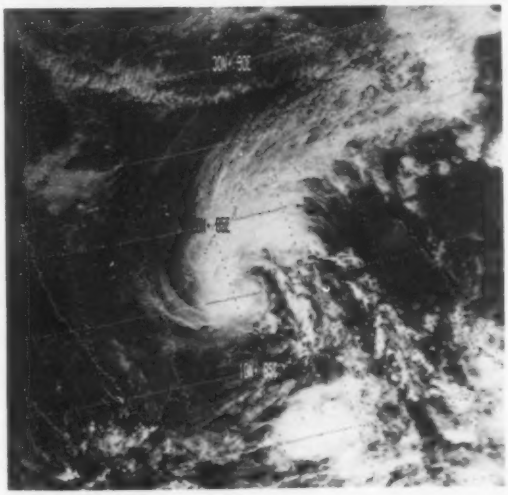

Figure 22.--The Himalayan Mountains to the north seem to form a protective barrier against the large Bay of Bengal hurricane as it advances northward on December 8.

Figure 23.--Hurricane Beryl (right) peaks off the north coast of western Australia, while tropical storm Annie (left) begins to weaken as she recurves westward early on the 2d.

Figure 24.--One of the year's best looking hurricanes, Diedrie, reaches maturity on the 27th. Notice her gorgeous clockwise circulation.

casualties. Onshore damage was heavy, but news reports were sketchy.

The November tropical storms both reached peaks with winds of about 50 kt in the central Bay of Bengal. The earlier storm moved ashore near Calcutta on the 9th, while the latter one turned northeastward and made landfall in Bangladesh, just south of Chittagong.

SOUTH INDIAN OCEAN

Tropical cyclone activity during November and December was confined to east of 65°E. Tropical storm Annie was the lone November tropical cyclone, while two tropical storms and a hurricane developed during December.

Annie formed northwest of Cocos Island toward the end of November. She passed very close to the island on the 24th and 25th, on a meandering east-southeastward track. Reports of 45-kt winds were received from Cocos at the two observation times on the 25th. After some erratic movement, Annie recurved and headed westward on December 1. As she did so, she began to weaken over the next several days (fig. 23). A week later, on the 12th, Cecily formed near 10°S, 100°E. Two days after this, Christiane popped up about 300 mi southwest of Diego Garcia. Cecily became the better developed of the two. She maintained tropical storm strength for about 4 days. The PILT encountered 40-kt winds near Cecily's center on the 14th. By the 18th, the storm had petered out. Meanwhile, Christiane had moved slowly southeastward in a depression stage. However, on the 18th, the PEEO encountered a southerly 40-kt wind about 60 mi west of Christiane's center. The storm turned a counterclockwise loop before dissipating on the 22d. While all this activity was going on, Diedrie was developing about 200 mi north of where Cecily was first spotted a week earlier. Diedrie moved west-southwestward. On the 25th, she became a hurricane and, by the 27th, 100-kt winds were roaring around her center and gales extended out to 200 mi (fig. 24). Diedrie maintained hurricane strength until the 29th, when she began recurving southeastward. She weakened rapidly and was a depression by the 30th.

SOUTH PACIFIC REGION

Off northern and western Australia, two hurricanes formed in November, followed by a tropical storm in December. Off the northeast coast, December was the active month, with a tropical storm and a hurricane.

Both November hurricanes made landfall over Western Australia. Inez formed just north of Arnhem Land in the Arafura Sea on the 18th. By the 20th, she became a hurricane, and winds rose to 85 kt near her center. Early on the 21st, Troughton Island, 100 mi to the south, was buffeted by 30-kt winds, while Kupan, on Timor, 180 mi northwest of Ines' center, reported 40-kt winds. Later in the day, her center crossed the Australian coast, just west of Cape Londonderry. Once inland, Ines gradually became a large, sprawling low-pressure system and persisted for another week. Meanwhile, Beryl was coming to life on the 27th, just south of the eastern tip of Java. By December 1 (fig. 23), 65-kt winds blew around the hurricane's center. Gales extended out to about 150 mi. Beryl weakened slightly before she crossed the coast near the Northwest Cape early on the 3d. She persisted over land as a weak low-pressure system until the 6th. Erica, the December storm off Western Australia, formed on the 27th. She didn't reach tropical storm strength until the 31st, when an unidentified ship passing close to her center encountered a 40-kt wind. Erica passed close to the Northwest Cape on the 1st, but never made landfall. By the 3d, she was a weak depression heading southward.

Off northeastern Australia, Lottie formed on about

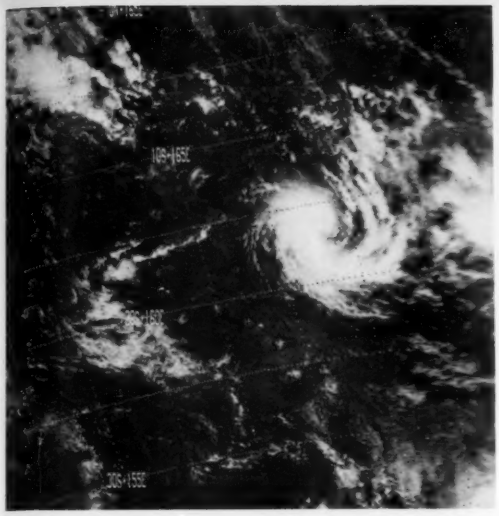

Figure 25.--Hurricane Lottie blankets the Fiji Islands and leaves the New Hebrides in her wake late on the 7th.

the 4th. As a depression, she moved eastward between the Solomon Islands and the New Hebrides Islands on the 5th. The following day, she intensified to tropical storm strength and turned southward toward the Fiji Islands (fig. 25). Lottie became a hurricane on the 8th. Early the next day, heading eastward, she passed within 60 mi of Viti Levu and even closer to Kandaru. Winds on these islands must have been near hurricane force. The only report on the weather charts was a 30-kt wind from Nambouwalu, some 100 mi to the north. Lottie weakened and turned southeastward on the 10th. By the 11th, she was a rapidly moving extratropical LOW. The PORT ALFRED encountered 35-kt winds some 200 mi southwest of the LOW's center early on the 12th.

Tropical storm Una formed in the Coral Sea on the 16th. Two days later, she moved across the Great Barrier Reef and made landfall on the Queensland Coast near Bowen. Una came back out on the 20th near Mackay. She had retained tropical storm strength. Lady Elliot Island was buffeted by 40-kt winds, while 30-kt winds were reported on Pine Islet. Una headed southeastward and gradually weakened.

COMING SOON

In the May issue, this column will have the details of the January floods that hit the Port of Brisbane, Australia, and other areas of Queensland and New South Wales. Some of the worst flooding on record in these areas was triggered by week-long rains of up to 25 in. Severe flooding of the Brisbane River resulted in the closing of the port and extensive damage to the city. Massive silting trapped several ships upriver. Damage is estimated to be in the millions of dollars, and at least nine people died.

On the Editor's Desk

ROUTES OIL SUPERTANKERS MAY TAKE FROM ALASKA ARE BEING SURVEYED

A 5-yr program has been launched for detailed surveys of the tides and currents in Washington State-British Columbia waters, through which giant oil supertankers may travel enroute from the Alaskan pipeline terminal.

The surveys are needed to ensure safe navigation for the tankers in the often hazardous and restricted waters leading to an oil refinery at Cherry Point, Wash., near the United States-Canadian border, and future refineries in this vicinity (fig. 26). They will provide data for more reliable predictions of tides and tidal currents.

When the 800-mi pipeline from Alaska's North Slope to its nearly ice-free port of Valdez is completed, possibly in 1976, it will carry up to 2 million barrels of oil daily for delivery to tankers which will transport the fuel to West Coast ports.

Modern supertankers are of such deep draft that they require accurate predictions of stages of the tide, as well as depth soundings, in order to navigate many waterways.

The surveys are being made by the United States, in cooperation with the Canadian Government. Two American ships will be involved in the project, the NOAA Ship McARTHUR, and the ONAR, an oceano-

Figure 26.--Supertanker route to be surveyed for Alaska oil transport.

graphic research vessel of the University of Washington. Current-measuring meters will be planted in the waterways by the National Ocean Survey, the University of Washington, and the Canadians. Gages will be installed along the shores to record the rise and fall of the tide.

The marine data will be processed by the NOS oceanographic facilities in Rockville, Md.; the Environmental Research Laboratories' Pacific Marine Environmental Laboratories, in Seattle, Wash.; the University of Washington, in Seattle, Wash.; and the Canadians, in Victoria, British Columbia.

Preliminary surveys for the project were carried out last fall by the McARTHUR and the actual survey began in mid-February. The McARTHUR will maintain a 5-mo annual schedule of surveys, working each year from mid-February to the end of April and from early September to mid-November. During the summer, it will conduct tide and current surveys in Cook Inlet, Alaska.

In addition to the work now being programed, the NOAA Ship DAVIDSON last year surveyed for submerged navigational hazards a deep draft channel which may be used by the tankers. The channel extends from the Strait of Juan de Fuca through Rosario Strait. The area was examined to a depth of 90 ft.

OCEAN CURRENT DATA OBTAINED BY THREE UNIVERSITIES AVAILABLE

The Environmental Data Service's National Oceanographic Data Center has three new instrument-measured ocean current data files available that were obtained from Nova University, University of Hawaii, and Woods Hole Oceanographic Institution. The data from Nova University were taken by a method in which the instrument falls freely to a preselected depth, releases its ballast, and returns to the surface. The University of Hawaii data were taken by use of moored buoys primarily in depths of up to 100 m (several as deep as 1,000 m) and by use of paddle wheel and Geodyne self-recording current meters. The current data obtained from WHOI, collected with Richardson type meters, contain a large number of observations taken off the east coast of the United States as far east as longitude 63°W. This collection also includes observations taken in the Denmark Strait, the Western Mediterranean, the Sea of Japan, and other areas off Japan. All data are on magnetic tape or punched cards and can be obtained in the originator's format.

Requests for these data, documentation, and other specifics should be addressed to the National Oceanographic Data Center, NOAA, Rockville, Md. 20852.

SAN PEDRO PMO AWARDED BRONZE MEDAL

Anthony E. Rippo, Port Meteorological Officer at San Pedro, Calif. (fig. 27), was awarded the Department of Commerce Bronze Medal Award for "individual leadership in the program to recruit cooperating merchant ships into the marine weather reporting service."

He has served as the National Weather Service representative in the Los Angeles-Long Beach port area for 14 yr, with additional responsibility in the port of San Diego. Tony Rippo, or "Rip," as he is known in his home town, is thoroughly familiar with

Figure 27.--Tony Rippo flashes his usual accommodating smile, which has greeted thousands of cooperating mariners.

the Southern California marine scene. Born in San Pedro, he attended schools there and, as a young man, went to sea on a merchant marine tanker from that port. He left the sea to serve as a weather observer in the United States Air Force during World War II.

Returning to civilian life after the war, he joined the United States Weather Bureau and was assigned duty as a weather and radiosonde observer aboard ships in the Pacific Weather Project. He was in charge of a Weather Bureau unit aboard a Scripps Institution of Oceanography research vessel sailing out of San Diego, the port from which he had first gone to sea as a teenage crewman aboard a tuna clipper fishing in tropical waters. He was later in charge of similar units on merchant marine vessels, United States Navy ships in Pacific service, and on Coast Guard cutters in the North Pacific Ocean Station Vessel program.

During service at San Pedro and two prior years as Port Meteorological Officer at San Francisco, he has made over 30,000 visits to merchant ships of all flags to recruit observers and to service weather observing programs. His work, which has resulted in the generation of over 3 million shipboard marine weather observations, has provided meteorologists of all nations with data requisite to the maintenance of effective warning and forecasting programs for waters of the whole globe.

Able to get a job done correctly and quickly, and cheerfully willing to lend assistance wherever possible, Tony Rippo has made many friends aboard ship and in the maritime community. His knowledge of Southern California port areas and the surrounding cities and countryside has been used to advise and assist in the problems of seamen of many nations. Many a mariner has returned to his homeland to tell of a trip to Disneyland that was charted for him by Tony Rippo.

Over the years as Port Meteorological Officer, "tour adviser," and friend, Tony Rippo has built a

reputation for ability and performance, and now these qualities have been recognized by this well-deserved award. We congratulate him in this splendid achievement.

NWS PORT METEOROLOGICAL OFFICER PROGRAM EXPANDS

The National Weather Service Port Meteorological Officers made 8,847 ship visits during 1973, an increase of 11 percent over the 1972 figure. They also enrolled 494 new ships into this program of taking voluntary surface meteorological observations for NWS while they are at sea.

The program is conducted by NWS in support of the International Cooperative Ship Program sponsored by the World Meteorological Organization. The PMO's are administered by the NWS Eastern and Southern Regions, and the Overseas Operations Division at NWS Headquarters.

According to the Marine Program Manager in the Data Acquisition Division of the NWS Office of Meteorological Operations, which is the focal point for the PMO program, several changes made during the year are resulting in a more efficient operation of the program.

-- The installation of PMO's at the Weather Service Offices in Tampa, Fla. (Francis E. Poag), and Port Arthur, Tex. (David Harmon), brought to 11 the number of locations from which PMO's operate.

-- Ship visitation records and other necessary documentation no longer consume time of the PMO's themselves. Instead, William Hocking, who is stationed at the San Francisco, Calif., Custom House with PMO's Paul Arnerich and Walter Sitarz, takes care of all documentation for all the PMO's.

-- All PMO's now routinely receive statistics on ship reports, since the installation of quality control procedures initiated in DATAC. These give each PMO an idea of how ships under his supervision are performing.

In addition to those mentioned above, the PMO's are: Walter J. Stoddard and Thomas Garret, at the New York City Weather Service Office; William Gribble at the Atlantic Marine Center, Norfolk, Va.; William Kennedy, for the Great Lakes, at the Weather Service Forecast Office in Cleveland, Ohio; David Shawley, at the Weather Service Forecast Office in New Orleans, La.; Julius Soileau, at the Weather Service Office in Houston, Tex.; Anthony E. Rippo, at the Custom House, Terminal Island, Long Beach, Calif.; Donald Olson, at the Seattle, Wash., Weather Service Office; and William H. Metivier, Jr., at the Panama Canal.

SEALAND VENTURE FINDS DISABLED YACHT

On September 10, the 40-ft ketch RANGER, skippered by a man and his wife, left Camden, Maine, on a cruise to Bermuda. Thirteen days later and 60 mi from Bermuda, RANGER's rudder broke, setting the boat adrift. From September 23 until October 19, RANGER drifted helplessly. The vessel had no radio transmitter aboard, but was well equipped with food, flares, and a stubbornly optimistic crew.

The RANGER was reported overdue in Bermuda on September 25 and was the object of a massive communications search from September 26 until she was located on October 19. The U. S. Coast Guard's Atlantic Area Rescue Coordination Center on Governors Island, N.Y., ordered Ocean Weather Station Hotel and Communications Station Boston to make urgent marine broadcasts, and a Hydrolant was issued requesting all marine interests in the area ranging from Nova Scotia to Bermuda to maintain a sharp lookout for the vessel. However, only one ship, the SEALAND VENTURE, reported a sighting.

During their 26-day ordeal, the couple signaled their distress with many of the commonly recognized methods, but they could only watch helplessly as 21 ships passed within 3 mi of their position without diverting. They shot flares, fired rifle shots, burned rags, and inverted the national ensign to communicate their need for assistance. One of the passing ships acknowledged the RANGER's signals with a flashing light, but continued on its voyage when the stranded couple did not reply.

When SEALAND VENTURE located RANGER, she found the crew in good condition, but out of food and flares. She replenished the food and flares of the two crewmembers, who wished to remain with their boat, and, after reporting the RANGER's position to the Coast Guard, SEALAND VENTURE resumed her journey to Europe.

The New York Rescue Coordination Center ordered the USCGC CHILULA and an HC-130 aircraft to go to the 32.3°N, 69.3°W position reported by SEALAND VENTURE. To help locate RANGER, the computerized Search and Rescue Planning System (SARP, described in 9/10:73 AMVER Bulletin) was called on to predict RANGER's drift position for the following day.

On October 20, the HC-130 located RANGER at 32.3°N, 69.8°W, only 5 mi from the SARP-predicted position. CHILULA took the couple and their dog and cat aboard and towed RANGER to Morehead City, N.C.

One aspect of this incident is alarming, and merchant vessel masters should consider ways to rectify it. This is that 21 ships passed within sight of RANGER and none reported sighting the small boat. All vessels should have been alerted to RANGER's plight by both the urgent marine broadcast and the Hydrolant.

When an urgent marine broadcast is received, the master of each ship should ensure that the lookout and bridge watch are aware of the situation and watching for a possible flare or other distress signal. Furthermore, it should be remembered that most pleasure craft operators cannot read or send flashing light, and other means of communicating must be used.

CASUALTIES ABOARD U.S. COMMERCIAL VESSELS

A total of 4,977 ships were involved in 3,108 casualties during the year ending June 30, 1973, according to a tabulation contained in a recent issue of the Proceedings of the Marine Safety Council. Storms or adverse weather were the primary cause of 259 of the 4,977 individual casualties, and unusual currents were the primary cause of 63 of these casualties. There were 131 deaths and 74 injuries as a result of 108 ship casualties; three of these casualties were the result of collisions in fog, while four were due to heavy weather damage. Fifteen deaths were attributed to heavy weather.

In addition to the above deaths and injuries, there were 333 deaths and 1,168 injuries aboard ships not

involved in ship casualties. Natural causes accounted for 123 of these deaths; 111 persons fell overboard and drowned, and only 8 deaths were primarily attributed to weather conditions (7 fell overboard). Sixty-three of the injuries were a direct result of weather.

Casualties involving commercial vessels are required to be reported to the U.S. Coast Guard whenever the casualty results in 1) actual physical damage to property in excess of $1,500, 2) material damage affecting the seaworthiness or efficiency of a vessel, 3) stranding or grounding, 4) loss of life, and 5) injury causing any person to remain incapacitated for a period in excess of 72 hr, except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.

TWENTY RESCUED AS THEIR VESSEL SINKS IN ATLANTIC

While performing offshore fishery patrols on December 4, the USCGC ALERT intercepted a distress call on 500 kHz from an unknown vessel at 1137. Pleading for help, the ship stated that water was coming into the holds. It gave its position as somewhere between 30°N, 71.7°W, and 40°N, 71.7°W, but failed to state its name or call sign.

While ALERT set a new course for the vessel's approximate location, an AMVER surface picture was requested to determine what vessels were in the general area. Because the vessel's position was vague, a distress broadcast was issued advising ships in the area to keep a sharp lookout and requesting them to notify the Coast Guard of any distress sightings.

At 1350, a C-130 from Coast Guard Air Station, Elizabeth City, N.C., departed for the area with two pumps on board. Two Coast Guard vessels, the TANEY, on Ocean Weather Station Hotel, and the UNIMAK, also headed for the area. Having heard the distress broadcast, two merchant vessels, the GYPSUM QUEEN and the ROBERT L.D., were steaming to the scene.

The distressed vessel, which turned out to be the AEGIS DUTY (fig. 28), was finally located at 1624 at position 38.8°N, 71.9°W, by a Coast Guard HU-16E amphibious aircraft which had been diverted to the area from a routine patrol.

By 1835, a Coast Guard HH-3F helicopter from

Figure 28.--The AEGIS DUTY slowly settles to the bottom in relatively calm seas. Note the deck is awash forward of the housing.

Coast Guard Air Station, Brooklyn, had evacuated an ill crewman and had verified that all crewmembers were accounted for. Two hours later, ROBERT L. D. arrived on scene and rescued the remaining 19 survivors from lifeboats.

When UNIMAK arrived at the scene at 2114, she retrieved the abandoned liferaft and secured the lifeboats alongside. ROBERT L. D. transferred the survivors to UNIMAK, which remained on scene throughout most of the night, until AEGIS DUTY sank. She then set course for Governors Island, N.Y., where the survivors were disembarked.

This case illustrates the need for all merchant vessels to participate in AMVER. Had all the vessels in the distress area been on AMVER plot, the rescue center could have known more quickly what vessel was in distress and thus could have determined what her most probable position was. This would have saved time and the unnecessary divergence of vessels that were not needed. As we have said before, the key to AMVER's success is cooperation. Therefore, remember to send your AMVER messages wherever in the world you sail.

Editor's Note: This item was taken from the January/February 1974 issue of the AMVER bulletin. A summary of AMVER's operations for 1973 is shown in table 6. Participate in AMVER and the weather reporting program.

Table 6.--Summary of AMVER 1973 operations.

	Atlantic	Pacific	Total
Separate Vessels Plotted			6075
Separate Voyages Plotted	61,996	36,216	98,212
Vessels on Plot			
Average Daily Plot Size	985	796	1781
Maximum Daily Plot/	1091/	940/	2020/
Month of Occurrence	Mar.	Feb.	Feb.
New Particiyants	--	--	1194
Surface Pictures Furnished	2543	3110	5653
Type of Case			
Aircraft	30	44	74
Disabled	155	71	226
Medico/Doctor	353	266	619
Man Overboard	160	12	172
Fire	13	30	43
Overdue	12	15	27
PIO/Drill	244	262	506
Precautionary	1476	2383	3859
Sinking	100	27	127
Visitors to the AMVER Center	--	--	948

NEW DATA AVAILABLE ON COASTAL AREAS OF FLORIDA, GEORGIA, AND THE CAROLINAS

New ocean environmental data are now available for four southeastern States following completion of the first year of a 2-yr concentrated investigation of coastal waters off Florida, Georgia, and the Carolinas.

The investigation was conducted by four vessels, an aircraft, and several field parties of NOAA, as part of a new program designed to compress into 2 yr projects previously scheduled for completion in 15 yr. Similar concentrated investigations are planned for other east, west, and Alaska coastal areas.

The project began last January and continued until November 1973. The second and final phase will begin in April. Impressive results have been recorded so far in the program, which is designed to provide marine information about coastal zones to assist federal, state, local, and private agencies in making decisions concerning environmental problems.

The following data are now available from the 1973 phase of the operation, known as SCOPE (Southern Coastal Plains Expedition):

1. Tidal current data in the following coastal areas: Charleston Harbor, S.C., and southward to and including Ossabaw Sound, Ga.

These data are in various stages of processing and will be available in various forms, including magnetic tape, printouts, computer-plots, and data analysis forms, from the National Ocean Survey (C33), Rockville, Md. 29852. In due course, the data will be incorporated in the tidal current tables published by the agency; they are also scheduled to be deposited in the National Oceanographic Data Center in increments over the next several months.

The data provide information on the speed and direction of the water that flows in and out of the estuaries, information essential to coastal planning, especially in determining the dispersion of pollutants. In connection with the latter, a special study was made aboard a NOAA ship by the Smithsonian Institution to determine the type of suspended sediments, including pollutants, in Port Royal Sound, S.C. This information is available from the National Ocean Survey (C33) or the Smithsonian Institution, attention J.W. Pierce, Curator, Division of Sedimentology, Museum of Natural History, Washington, D.C. 20560.

2. Shoreline maps which depict the high and low waterlines as determined by aerial photography.

Copies of these maps can be obtained from the National Ocean Survey (C3415). They are important in determining shoreline boundaries, including Federal, State, and private. The area covered is from Morehead City, N.C., to St. Augustine, Fla. Not all maps are completely processed yet.

3. Aerial photographs. Coastal planners can use these for studies of the shoreline and for any type of shoreline construction. The boundaries (the high and low waterlines) along the coast can be physically seen, although it may be necessary sometimes to enlarge segments of photos to achieve this. The photographs can be obtained from the National Ocean Survey (C3415) for the coastal area extending from Morehead City, N.C., to Cape Canaveral, Fla.

4. Field sheets (also known as boat sheets) which provide in great detail (much more so than on nautical charts) ocean soundings along the coast. Copies of these sheets are now available from the National Ocean Survey (C3233) for the outer coast areas from the Cape Fear River, N.C., to the vicinity of Savannah, Ga., and along the Florida coast from False Cape to Daytona Beach.

The information is important to commercial shipping, recreational craft, and coastal engineering. It also provides a picture of the sea bottom, useful in almost any study of the area, whether for engineering or scientific purposes, or in connection with petroleum research and the recovery of minerals on the

Continental Shelf.

Other data gathered in the project will be reflected later in updated nautical charts and tide and tidal current prediction tables. These data are important not only to ship navigation, but to all types of coastal engineering, including the construction of buildings and other structures, such as piers and seawalls.

LLOYD'S REGISTER OF SHIPPING

The 1973 Lloyd's Register of Shipping Statistical Tables came across the editor's desk, and some facts were of interest to me, and may be to some mariners.

The tonnage of steamships and motorships of 100 gross tons and upwards of the principal merchant fleets of the world, compared with 1972, is shown in table 7. The world commercial trading fleet is principally composed of the type of ships shown in table 8.

Table 7.--Principal merchant fleets of the world

	thousand tons gross	
Liberia	49,905	(+5,461)
Japan	36,785	(+1,856)
Great Britain and N. Ireland	30,160	(+1,535)
Norway	23,621	(+ 114)
Greece	19,295	(+3,966)
Russia (U.S.S.R.)	17,397	(+ 663)
U.S.A.	14,912	(- 112)
Panama	9,569	(+1,775)
Italy	8,867	(+ 680)
France	8,289	(+ 869)
Germany, Fed. Rep. of	7,915	(- 601)
Sweden	5,669	(+ 37)
Netherlands	5,029	(+ 57)
Spain	4,833	(+ 533)
Denmark	4,107	(+ 87)
Cyprus	2,936	(+ 921)
India	2,887	(+ 237)
Canada	2,423	(+ 42)
Brazil	2,103	(+ 218)
Poland	2,073	(+ 60)
Singapore	2,004	(+1,133)
Yugoslavia	1,667	(+ 79)
Somali Republic	1,613	(+ 740)
Finland	1,546	(- 84)
China, People's Rep. of	1,479	(+ 298)
China (Taiwan)	1,467	(- 28)
Argentina	1,453	(+ 52)
Portugal	1,272	(+ 245)
German Democratic Rep.	1,219	(+ 21)
Belgium	1,162	(- 30)
Australia	1,160	(- 24)
Korea (South)	1,104	(+ 47)
WORLD TOTAL	289,927,000 tons	(+21,587,000)

Table 8.--Types of the world trading fleet

	thousand tons	
Oil tankers	115,365	(+10,236)
Liquefied gas carriers	2,276	(+ 389)
Chemical tankers	652	(+ 101)
Bulk/oil carriers	19,539	(+ 4,466)
Ore and bulk carriers	53,110	(+ 4,695)
General cargo	69,506	(- 1,085)
Container ships	5,899	(+ 1,589)
Other vessels	1,688	(- 32)
Total	268,035	(+20,359)
Non-trading types	21,892	(+ 1,228)
WORLD TOTAL	289,927	(+21,587)

The world total of oil tankers of 100 tons gross and upwards has increased by over 8 percent during the year, and represents 39.8 percent of all steamships and motorships. Ore and bulk carriers (over 600 tons gross, including bulk/oil carriers) increased 9 million tons, and is 25.1 percent of the total. General cargo ships decreased slightly. Fully cellular container ships have reached 5.9 million tons.

The number of ships of 100,000 to 140,000 tons gross (200,000 to 275,000 tons deadweight, approximately) and upwards totals 293. The number of ships over 140,000 tons gross (275,000 tons deadweight) totals 29, and includes 5 ore/bulk/oil carriers.

Approximately 63 percent of the world fleet is less than 10 yr of age; 6 percent is over 25 yr old. Japan has the most modern fleet of the principal countries. Forty-eight percent of the United States' fleet is more than 25 yr old.

Over 64 percent of the world fleet has diesel propulsion.

PLANS ANNOUNCED TO EXTEND LONG-RANGE STORM EVACUATION MAPPING PROGRAM

Long-range plans to extend a storm evacuation mapping program to an additional 41 coastal areas were announced by the National Oceanic and Atmospheric Administration.

The maps show emergency evacuation routes for use during flooding from hurricanes and other high waters, as well as areas subject to flooding and elevations which might afford "safety islands" for storm evacuees. Subject to future budgetary and manpower resources, the program contemplates issuing approximately 12 maps annually over the next 13 yr, for coastal areas extending from Maine to Texas. The maps are prepared by NOAA's National Ocean Survey from existing surveys, supplemented by recent aerial photography and field data, and are distributed by NOAA's National Weather Service to State and local officials and community preparedness committees. Copies are also available to the public.

Storms, particularly hurricanes, on or along the Atlantic and Gulf coasts, at times cause extensive flooding of low-lying coastal regions. The National Weather Service maintains a close watch on the storms, predicting the height of the storm surge and issuing warnings for areas subject to flooding. The program was instituted by NOAA to fill a need for special-purpose maps to facilitate evacuation of people from endangered areas.

It was estimated that approximately 160 maps will be needed to cover the entire Atlantic and Gulf coasts, in addition to the 25 maps already issued for coastal areas in Louisiana, Alabama, Mississippi, Texas, South Carolina, Georgia, and Virginia. Priorities for the maps are established by the National Weather Service and are based on the frequency of tropical storms and hurricanes reaching the United States mainland from 1886 to 1970.

Following is a list of the areas covered under the long-range program.

1974 - New York and vicinity
New Orleans to Mississippi Delta, La.
Houma to New Iberia, La.

1975 - Beaumont to Port Arthur, Tex.
Mobile, Ala., to Pensacola, Fla.
Tampa Bay and vicinity, Fla.

1976 - Sarasota to Naples, Fla.
Miami to West Palm Beach, Fla.
Nantucket to Cape Cod, Mass.

1977 - Block Island, R.I., to Nantucket, Mass. (south shore)
West Palm Beach to Melbourne, Fla.
Pine Point to Apalachee Bay, Fla.

1978 - Pensacola to Panama City, Fla.
Key West to Islamorada, Fla.
New Iberia to Lake Charles, La.
1979 - Pamlico Sound and vicinity, N.C.
Islamorada to Miami, Fla.
Apalachicola Bay and vicinity, Fla.
1980 - Wilmington to Cape Lookout, N.C.
Matagorda Bay and vicinity, Tex.
Myrtle Beach, S.C., to Wilmington, N.C.
1981 - Bar Harbor to Eastport, Maine
Hudson to Pine Point, Fla.
Brownsville to Armstrong, Tex.
1982 - Albemarle Sound and vicinity, N.C.
Armstrong to Corpus Christi, Tex.
Naples to Cape Sable, Fla.
1983 - Charleston to Myrtle Beach, S.C.
Bar Harbor to Brunswick, Maine
Melbourne to Daytona Beach, Fla.
1984 - Daytona Beach to Jacksonville, Fla.
North Shore of Connecticut on Long Island Sound
Savannah to Brunswick, Ga.
1985 - Delmarva Peninsula to Delaware Line, Md.-Va.
Lower Chesapeake Bay to Point Lookout, Md.
Upper Chesapeake Bay, Md.
1986 - Delaware Bay area, Del.-N.J.
Beach Haven to Sandy Hook, N.J.
Cape May to Beach Haven, N.J.
1987 - Lewiston, Maine, to Mass.-N.H. line
Massachusetts Bay and vicinity, Mass.

The maps include a delineation of areas subject to flooding by surges at various heights; the main evacuation routes and feeder roads; low points along the roads that might be engulfed; and high spots which are likely to remain unaffected by flood waters, thus affording some degree of refuge. Population figures are provided for major urban areas.

The maps show areas subject to flooding in increments of 5 ft, in distinctive color tones. Both surfaced and unsurfaced evacuation routes are identified, along with county, State, and Federal route designations and the number of lanes for each road. The maps also depict railroads which may offer avenues of escape. Details are sufficiently clear, so that the maps can be reproduced by mass circulation media, including newspapers and television.

To date, maps have been issued for three Gulf Coast areas, including five for New Orleans, La., to Mobile, Ala.; six for Galveston to Houston, Tex.; and four for the Corpus Christi, Tex., area. On the Atlantic coast, six maps cover the area from Charleston, S.C., to Savannah, Ga., and four cover the Norfolk-Virginia Beach area. The maps can be purchased for $2 each from the National Ocean Survey, Distribution Division (C44), Riverdale, Md. 20840.

ORE CARRIERS TO AGAIN PARTICIPATE IN LAKES WINTER NAVIGATION TESTS

The ore carrier LEON FRASER, owned by United States Steel Corp., again participated in winter navigation tests on the Great Lakes, in a project aimed at improving vessel performance in ice. The project, sponsored jointly by U. S. Steel and the Maritime Administration, had the two-fold purpose of evaluating

Figure 29.--The value of the air coating system is dramatically illustrated in this photo showing the LEON FRASER moving through an ice field. ARCTEC Photo.

an air coating system for Lake shipping which could ease vessels through ice and to measure ice pressure on hulls (fig. 29).

The vessel, measuring 640 ft in length and with a 16,000-ton cargo carrying capacity, participated in convoys on the Lake ice fields last winter, along with a number of other carriers. The mild winter, however, and the resulting lack of major ice accumulations made it impossible to complete the test program.

Engineering data were obtained while the vessel was engaged in normal operations carrying taconite pellets from Two Harbors, Minn., to steel mills on Lakes Michigan and Erie. The route ore carriers take on trips from Two Harbors to the steel mills traverses several areas where ice is oftentimes compacted to depths of over 6 ft, as a result of wind and water conditions. The areas are Whitefish Bay, St. Mary's River, and Mackinac Straits.

The air coating system has been developed by ARCTEC, Inc., at its ice model basin in Columbia, Md., in a program sponsored by the Maritime Administration. The purpose of the system is to provide a lubricating film of water and air between a vessel's hull and compacted ice.

Reduced ship resistance is accomplished by the rapid discharge of low-pressure air through small holes in manifolds outside the hull. Rapid rise of the

air causes an upwelling of water, the air-water mixture providing the needed lubricating film.

According to ARCTEC, the system should reduce the danger of a vessel becoming stuck, allow for higher speeds, and enable a carrier to extract itself from a stuck position in heavy ice conditions. The system is not designed to reduce icebreaking resistance in solid ice sheets, however,

Model tests resulted in the selection of the air coating system over that of water jets and detachable icebreaking bows for improving vessel performance in broken ice fields. A full-scale system was installed on the LEON FRASER in November 1972.

Ice force data had been collected in 1972 by the vessel while being escorted by an icebreaker, unassisted while in broken ice fields, breaking 4 in of solid ice, and breaking a foot of refrozen ice.

The LEON FRASER began its test trips January 2, and the project continued through early February.

NOAA SCIENTISTS DOCUMENT NORTHERLY CURRENT OFF WASHINGTON-OREGON COASTS

A 30-mi-wide current, flowing northward off the coasts of Washington and Vancouver Island, has been documented by scientists with NOAA, as part of a project to define offshore currents in the Northwest--a study of particular interest to fishermen, shipping, and environmentalists.

The Seattle-based Pacific Marine Environmental Laboratory (one of NOAA's Environmental Research Laboratories with headquarters in Boulder, Colo.) reports the northerly flow appears to be continuous from the mouth of the Columbia River to north of the Strait of Juan de Fuca. Usually beginning 20 to 30 mi from shore, the broad ribbon of water occurs seaward from a point where the water depth is about 1,000 m (3,280 ft).

Knowledge of the ocean's currents here is particularly important to commercial fishermen, because their catches feed upon current-borne fish larvae and minute drifting organisms called plankton. If the current is strong enough, it could also affect the drift and motion of fishing vessels in the vicinity, which often depend on the currents to carry them when engines are shut down.

Moreover, environmentalists as well as oceanographers stress the importance of knowing the offshore current structure in preparation for the 2 million barrels of North Slope oil which will be shipped daily from Alaska's Port Valdez aboard tankers bound for West Coast ports--principally Seattle, San Francisco, Los Angeles, and San Diego.

Prior to the recent research project, there had been indications of a northerly flow along the Northwest coast, but it was never well defined. It now appears that the flow is not only continuous, but its maximum velocity seems to occur at about 150 m (nearly 500 ft) below the ocean's surface. Above that depth, the current is characterized by a slow surface flow; below that depth, it also decreases and is essentially zero at 1,000 m.

The normal topography of the seafloor (or bathymetry) is characterized by a broad, shallow slope from the beach to the edge of the Continental Shelf, where the seafloor drops off abruptly. Although the Juan de Fuca Canyon cuts across the continental slope and shelf and actually extends into the mouth of the

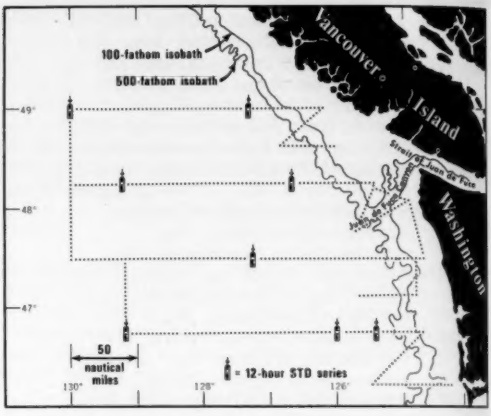

Figure 30.--Area surveyed by the OCEANOGRAPHER to determine currents off the Washington coast.

Strait of Juan de Fuca, the northerly current passes seaward of the canyon, and so is not disturbed by that bathymetric feature.

However, the Continental Shelf represents a barrier to the incoming wave of the astronomic tide, causing formation of internal waves, which are reflected shoreward and back to sea.

Research was undertaken specifically to determine the effect of these internal waves which cause errors in computed currents by disturbing the density field. For this reason, the computed values of the currents were not reliable. By determining the magnitude of the oscillations caused by the internal waves, it is now possible to compute more accurately the true currents in the area.

To monitor the densities and oscillations, the research project was conducted during a 2-wk period in September 1973 aboard the NOAA ship OCEANOGRAPHER, based in Seattle. The 27,000-sq-mi area covered by the OCEANOGRAPHER was bounded on the north by 49°N, the latitude of the United States-Canadian border; on the south between 46° and 47°N, near the mouth of the Columbia River, just north of Astoria, Oreg.; on the west by 130°W; and on the east by the coasts of Washington State and Vancouver Island, Canada (fig. 30).

Using the STD--a device which measures salinity, temperature, and depth electronically--a total of 150 casts were made to depths varying from less than 100 m (about 300 ft) to a maximum of 1,500 m (4,875 ft). Of the total, 69 casts were obtained at eight stations at 1-1/2-hr intervals over 12-hr periods.

NOAA FORMS OCEAN REMOTE SENSING LABORATORY IN MIAMI

A laboratory dedicated to studying the oceans from satellites, aircraft, and other remote platforms has been created in Miami, Fla. The new Ocean Remote Sensing Laboratory will be one of the Atlantic Oceanographic and Meteorological Laboratories (part of NOAA's Environmental Research Laboratories, with headquarters in Boulder, Colo.) which occupy a major oceanographic research facility on Virginia Key near Miami.

Research emphasis will be on studying such physical and chemical aspects of the oceans, estuaries, and oceanic boundary layer as can be determined via remote sensing from spacecraft, aircraft, buoys, and ships; and to develop new instruments and techniques with which to do this.

The threshhold of knowing how to use satellite sensors to observe the oceans has barely been crossed, and technology in this area is progressing at an extremely rapid rate. We expect that "ocean-tuned" satellites will eventually give oceanographers a flow of information and a breadth of vision comparable to that which meteorologists have had from weather satellites.

At present, research uses oceanic data from existing satellites--for example, the high-resolution images from NOAA spacecraft and NASA's first Earth Resources Technology Satellite, ERTS-1, which were not designed primarily to gather oceanic data. Help is being provided to guide programs in new ocean-looking satellites and sensors, now in their early development stages.

The other side of the effort is to apply the remote-sensing tools of the trade to ocean research conducted from ships and aircraft. Some of these are microwave radiometers, laser and lidar (the laser equivalent of radar) sensors, acoustic sounders, infrared and visible sensors, precise radar altimeters, and microwave scatterometers.

Among the Ocean Remote Sensing Laboratory's planned projects are studies of major current systems and hurricane-ocean interactions using data from GEOS-C, the geodetic satellite planned for a 1974 launch; Gulf Stream dynamics and internal waves using data from the second Earth Resources Technology Satellite (ERTS-2); and various studies of surface and internal wave dynamics in the sea, using available satellite data and acoustic remote sensing from ships.

SAHARA DUST, TROPICAL WEATHER, POLLUTION, AND SOLAR ENERGY BALANCE LINKED

A record of the 5-yr drought which still plagues the African nations south of the Sahara is written in the skies as far away as the Caribbean Sea, where scientists find that dust from Africa--in increasing amounts since the drought began--may affect tropical weather, disturb the solar energy balance, and diminish regional air quality.

According to the National Hurricane Research Laboratory and the University of Miami, the hot desert winds blowing across the scorched sub-Saharan grasslands pick up large quantities of the area's topsoil and carry it across the equatorial Atlantic in well-defined "lenses" of warm, dusty air.

Scientists have noted that since this large-scale transport of African dust began to be measured systematically in 1965, in Barbados, West Indies, dust concentrations have risen markedly--1973 concentrations were 60 percent greater than 1972 values, and there has been a three-fold increase in dust levels since 1968, the period corresponding to the drought.

The effect of these increases has been to increase atmospheric turbidity (or decrease atmospheric transparency) to the point where the typical marine conditions one normally finds there have been transformed into the hazy conditions of urban industrialized regions of North America. The difference is that the "pollution" consists of natural soil particles, and is concentrated much more at 10,000 ft than at the surface. It is believed that the dusty layer of Saharan air also removes a significant amount of solar energy from the sun's rays, altering the solar energy balance of the tropical Atlantic.

As the solar radiation comes down through the atmosphere, the dust absorbs some of the energy and scatters additional amounts back to space. Our measurements suggest that the three-fold increase in dustiness since the start of the African drought has contributed to a 10- to 15-percent reduction in solar energy reaching the sea surface in the tropical Atlantic.

The transport of the Saharan dust appears to occur in large-scale pulses from the African continent, with the pulses usually taking several days to cross the Atlantic to the Caribbean. Before it reaches the African coast, however, the air is subjected to prolonged, intense heating, which causes strong mixing in a desert air layer which may be 15,000 to 20,000 ft deep in summer. As this hot, dusty air emerges from the west coast of Africa, it is undercut by relatively cool, moist trade winds which confine the desert air to altitudes above 4,000 to 6,000 ft. Over the ocean, the warm desert air becomes sandwiched between the low-level, moist trade wind air below and the 15,000- to 20,000-ft level, which corresponds to the top of the desert mixing layer.

Research shows that the amount of dust collected in Barbados varies considerably from day to day, especially in the summer, when the atmospheric dust concentrations at Barbados are greatest. During winter, however, the dust content at Barbados is very much smaller than in summer, and the color is ash gray or black, in contrast to the light red-brown color of the summer's dust.

The onset of the maximum dust transport period is often rather abrupt and corresponds to the beginning of airflow from the western Sahara over the northern Equatorial Atlantic. This high dust transport period usually begins in late May and lasts until September or October. The probable origin of the red-brown dusts transported in the summer appears to be in an area encompassing southern Algeria, Mali, Mauritania, Senegal, Spanish Sahara, and Niger. From late fall until May, the source region of the black dust is primarily the more vegetated lands south of the Sahara.

Interest in this Saharan air layer was originally related to studies of disturbances traveling over the equatorial Atlantic. It was noticed that these large-scale masses of dusty air were sometimes visible on satellite photographs, and they often appeared to follow behind the traveling disturbances. Although the disturbances and the Saharan air layer are separate phenomena, the movement of the disturbances seems to influence the trajectories of the dusty air. The disturbances evidently interrupt the flow of Saharan air over the Atlantic, so that successive pulses of dusty air are generated along the African coast following the passage of the disturbances.

One of the interesting direct effects of the Saharan air layer on the weather of the tropical Atlantic, and possibly on the growth of tropical disturbances into

hurricanes, is the suppression of cumulus cloud growth by the Saharan air layer. Because of the original strong heating of the layer over Africa, the base of the Saharan air layer forms a very warm inversion at the top of the moist trades over the ocean, inhibiting the development of cumulus clouds.

It is planned to mount an extensive investigation of the Saharan air layer and how it interacts with tropical weather systems during GATE, the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment planned for 1974.

Editor's Note: Within the last year, the Mariners Weather Log has published two items concerning reports by ships of dust at sea. On January 27, 1973, the EXFORD encountered dust near the Cape Verde Islands (Vol. 17, No. 4, July 1973 issue); and the EXPORT BUILDER, June 12-15, 1973, south and west of the Cape Verde Islands (Vol. 17, No. 5, September 1973 issue).

LETTERS TO THE EDITOR

CORRECTIONS AND/OR ADDITIONS TO ADDRESSES OF PORT METEOROLOGICAL OFFICES

This note was received from Mr. Paul A. Arnerich, Marine Supervisor, San Francisco, Calif.

"Reference my address listing on the back cover of the January 1974 issue of the Mariners Weather Log:

"Our address listed there is our P. O. box. I feel that the best value of the listing is to let people know how to reach the Port Meteorological Officer. The mail and telephone numbers do the job for those who may want to write or telephone, however, I believe that street addresses should be shown for those who may wish to visit the office. For that reason, our office uses the street number in our letterhead. I think the same should be done for our listing in the Mariners Weather Log. This probably should also apply to other offices."

Editor's Note: The San Francisco Port Meteorological Office is located at: 219 A Custom House, 555 Battery Street. The Nederland, Tex., Port Meteorological Officer is located at the Jefferson County Airport, and his post office box number is now 1306. These two corrected addresses are listed on the back cover.

IMPORTANT: I suggest that when visits to the office are planned, telephone ahead of time to ascertain whether the PMO will be in, since he may be visiting other ships in the port and not in his office at that time.

MARINE WEATHER REVIEW

Smooth Log, North Atlantic Weather

September and October 1973

The SMOOTH LOG (complete with cyclone tracks [figs. 31-34], climatological data from U. S. Ocean Station Vessels[tables 9-11 and 13], and gale tables 12 and 14), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, SEPTEMBER 1973--This was a near-normal month. The storm tracks followed the climatic pattern in a general way, as they were fairly diffuse. The two major source regions were out of Ugava Bay and the Gulf of St. Lawrence. The cyclone centers out of northern Canada and Ugava Bay generally did not track any further east than the Labrador Sea. The cyclone centers out of the northern United States and southern Canada that entered the Atlantic near Nova Scotia continued northeastward toward Iceland.

A secondary source of cyclone centers was off the northwest corner of Spain. Their direction of movement after forming was not consistent, except for a northerly and easterly component. Many of the cyclone centers were continuous in only the broad scale, as individual centers dissipated and reformed.

The mean sea-level pressure pattern was a rough carbon copy of the climatological pattern. The Azores High dominated the central and southern area. The Icelandic Low had two centers: one, at 1003 mb, in the Labrador Sea, and the other, at 1004 mb, between

Kap Farvel and Iceland, near the climatological center of 1006 mb. The pressures and patterns over the eastern United States and western Europe matched the mean.

The largest anomaly--4 mb--occurred twice. A negative 4-mb anomaly center was near the 1003-mb low-pressure center, at 60°N, 50°W, and a positive 4-mb anomaly was centered off the African coast, near 30°N, 15°W.

September is noted for having the highest frequency of tropical cyclones of any month. An average of about three and one-third tropical cyclones can be expected, and two will develop to hurricane strength. This year, there were two: tropical storm Delia and hurricane Ellen. Since 1930, the largest number of tropical cyclones recorded for the month was seven in 1949. At least one has occurred every year, and in only 3 yr has none reached hurricane intensity. This year's tropical cyclones are described in the article, "North Atlantic Tropical Cyclones, 1973," on page 8 of the January 1974 issue of the Mariners Weather Log.

The first significant North Atlantic storm of the month can be traced from the Lake of the Woods area of northern Minnesota. At 1200 on the 2d, it was a 997-mb LOW centered in Ugava Bay. The N. B. MCLEAN, near Cape Mercy, had 40-kt easterly winds. Twelve hours later, as the LOW moved into the Labrador Sea, Resolution Island experienced freezing 35-kt northerly gales and VGBZ (which I have been told is a drilling rig) also reported 35-kt gales, but from the southwest.

At 1200 on the 3d, the 978-mb LOW was near 60°N, 55°W. SEDCO I, far to the south, suffered 40-kt gales. By 0000 on the 4th, the LOW split into two centers, both 986-mb. The new center was near 55°N, 41°W. The DAWSON, northeast of Hopedale, was lashed by 60-kt winds. At 0000 on the 5th, the BESSTRA was whipped by 50-kt north-northeasterly winds near the same area.

By 1200 on the 5th, the original LOW, which had moved toward the south, had deteriorated to only a trough. The new LOW had swung northeastward and was also filling. At 0000 on the 6th, its pressure was 998 mb. To the south, a wave developed on the front, near 45°N, 37°W, and the MANCHESTER QUEST, south of Argentia, was mauled by 50-kt winds. SEDCO I again registered 35-kt winds. As the LOW approached Iceland on the 7th, it could no longer be analyzed on the charts. The new wave was then developing, and the ATLANTIC CROWN was rolled by 35-kt winds on her starboard side. This LOW developed quickly, and faded just as quickly.

This cyclone developed as a tropical depression over the Yucatan Peninsula on the 7th. It moved across the Gulf of Mexico and crossed the Texas coast near Matagorda on the 11th. It then moved eastward and passed over Cape Charles late on the 14th. As the storm approached and passed over Texas, it drenched the coastal area.

At 1200 on the 15th, the 993-mb LOW was 200 mi southeast of Nantucket Island, and the QUEEN ELIZABETH II was whipped by 45-kt gales near her center. The LOW sped along the Gulf Stream and was over the Grand Banks 24 hr later. SEDCO I was pounded by 45-kt gales as the center approached. The QUEEN ELIZABETH II was following behind the storm and still receiving 35-kt winds on her port side.

As the LOW moved more easterly, it crowded another LOW just south of Iceland, and Ocean Station Vessel "J" measured 45-kt headwinds. The seas were running 18 ft, and the swells 23 ft. As the storm moved south of the Iceland Low, it lost some of its punch and only left rain as it passed over England. On the 21st, it moved across the Baltic Sea, to be lost in Siberia.

A large, complex LOW was located over north central Canada on the 9th and 10th. At 1200 on the 10th, a new 989-mb center, north of James Bay, broke away and started to drift eastward. By the 11th, this new system (981 mb) had become the primary circulation, covering all of central and eastern Canada. As the LOW continued to develop, the front raced ahead of the center. The EWCS, near Sable Island, reported a roaring 50-kt wind. The CAPE BRETON MINER and VGBZ were both beaten by 40-kt gales.

As the LOW passed over the coast near Cartwright on the 13th, it split into several centers and moved northward in the Labrador Sea. On the 14th, the rocky coast of southern Greenland was its burial ground.

For several days, the area between Spain and Newfoundland had experienced transient LOWs. At 1800 on the 11th, another LOW formed near 47°N, 34°W. It moved eastward and then southeastward on the 12th and 13th, prior to turning northward on the 14th. At 1800 on the 12th, the DOCTOR LYKES, near 43.1°N, 27.1°W, found 45-kt gales blowing from the northwest. The seas were 8 ft, and the swells, 11.5 ft. The wind and sea reports from ships passing near the 997-mb LOW did not indicate a severe storm. The LOW center circled south and east of Ocean Station Vessel "K" on the 14th and passed near "J" late on the 15th. Only winds of 25 kt and less were being reported.

Early on the 16th, the LOW combined with and absorbed a wave on a front that moved in from the west. This appeared to reinforce the storm. At 1200 on the 16th, the ELISABETH SCHULTE was pounded by 48-kt winds and 14.5-ft seas near 53.4°N, 26.4°W, in heavy rain and visibility of 1/4 mi. Further south near 48.5°N, 27°W, the GRIN was walloped by 35-kt gales, 20-ft seas, and 12-ft swells. At 0000 on the 17th, Ocean Station Vessel "J" fought 45-kt winds, 18-ft seas, and 23-ft swells. The 994-mb LOW was moving northwestward toward the east coast of Greenland, where it foundered late on the 17th.

The cold front that extended toward the southwest out of extratropical storm Ellen lay in a trough between two HIGHs; one over the Azores, and the other near Quebec. At 0000 on the 26th, two waves formed on this front. The southern center of circulation, near 34°N, 63°W, was the one that would survive and harass shipping. By 1200, the pressure had dropped to 1004 mb. The NIENBERG, near 36.5°N, 51.5°W, was tossed by 40-kt gales and 12-ft seas.

At 0600 on the 27th, the TILLIE LYKES, near 34°N, 50°W, was hit by 50-kt storm winds. By 1200, five ships were feeling the effects of this storm, with 35- to 40-kt winds and seas running to 13 ft. They were the

ADMIRAL CALLAGHN, CHRISTIAN MAERSK, CONTEST, TOCHIGI MARU, and an unidentified ship.

On the 28th, the Azores High bulged northward and, to the north, a LOW came out of Canada, blocking northward movement of the center located near 36°N, 53°W. The HOROMYA, within 60 mi of the center, battled 45-kt gales and swells of 23 ft. The LOW continued to be squeezed by the surrounding systems, but finally was able to start slipping northward. At 0000 on the 30th, the 995-mb LOW was at 51.5°N, 46°W. The QUEEN ELIZABETH II, southeast of the center near 49°N, 38°W, reported lightning and 35-kt gales. One hundred plus miles southwest of the QUEEN ELIZABETH II, the GALYA KOMLEVA was whipped by 40-kt gales and 20-ft seas.

At this same time, the HIGH to the east was moving northward and building. A LOW was also moving eastward out of the Gulf of St. Lawrence, and the gradient ahead of the front became very tight, although the winds did not become as strong as could have been expected. Ocean Station Vessel "C" and three other vessels measured 35-kt winds.

The now-small 993-mb LOW raced into the Denmark Strait, as if to hide from the more powerful bullies. It was to no avail--it could not withstand the combination of stresses.

This storm raced out of central Canada and across James Bay. By 1200 on the 29th, it was over the Gaspe Peninsula. The 993-mb LOW raised havoc with VGBZ, with 45-kt winds for the next 24 hr. The 987-mb center moved over St. John's, Newfoundland, early on October 1. The USCGC SHERMAN, south of Argentia, was whipped by 45-kt winds and 20-ft seas. Further south of the LOW, along approximately 41°N, the ATLANTIC CROWN and the ATLANTICA MONTREAL received 35-kt gales.

As the center moved over water, it turned northnortheastward. At 1200 on the 1st, the 988-mb center was at 52°N, 47°W. The VC 8062 was ravished by 50-kt winds and 25-ft seas. Twelve hours later, the LOW passed just southeast of Kap Farvel. Many miles to the south off the Grand Banks, the 5LBA was riding out 45-kt gales. As the LOW moved north into the Denmark Strait, the cold water rapidly sapped its energy.

Monster of the Month. Extratropical Ellen. Hurricane Ellen did not turn extratropical until the 23d, above 50°N. By 1200 on the 23d, the 984-mb center was near 54°N, 25°W. The WALTHER HERWIG was only 60 mi north of the center, and was pounded by 50-kt shifting winds and 20-ft seas. Ocean Station Vessel "C" and the QUEEN ELIZABETH II were treated to 40-kt gales.

By 0000 on the 24th, the pressure was down to 968 mb, when the center was west of Reykjavik. Ocean Station Vessels "A" and "I" both measured 40-kt winds, with "I" being bounced by 23-ft seas and 30-ft swells. The center moved over the Greenland coast at Angmagssalik. A report near 65°N, 27°W, off the west coast of Iceland, indicated 60-kt winds. Kap Gustav Holm reported 50-kt winds parallel to the coast. Gale winds were reported as far south as 50°N, between the longitude of Iceland and Kap Farvel.

The LOW moved southwest along the coast of Greenland and, at 0000 on the 25th, was over Kap Farvel. The pressure had increased to 978 mb. In the next 24 hr, Ocean Station Vessel "B" and the MURMANSK fought chilling 40-kt winds. During this 36-hr period, the following ships felt the wrath of this storm: Ocean Station Vessels "A," "C," and "I," the BURGENSTEIN, C. P. EXPLORER, CETRA LYRA, COTSWOLD, EUROFREIGHTER, HOHENLINDEN, and the MANCHESTER COURAGE. There probably were many others who either didn't report or whose reports were too late for plotting on the charts. Although tropical storms get much publicity, there were probably more ships involved with higher winds during the extratropical stage of this storm than the tropical stage.

On the 26th, the 984-mb LOW had circled and was again off Reykjavik. By this time, the gradient had relaxed, and only Ocean Station Vessel "B" reported winds as high as 40 kt. On the 27th, the LOW split into several centers and gradually disintegrated.

This was one of the LOWs that spun off of extratropical Ellen. It formed about 300 mi south of the old system on the 27th, and moved eastward. On the 28th, the system increased in intensity and the circulation was as far south as the Bay of Biscay. The EVELYN BOLTEN, headed for the English Channel, and Ocean Station Vessel "J" had 40-kt gales and seas of 20 ft. The AMERICAN ARCHER, headed west, was pounded by high winds and seas, starting at 1800, with 50-kt winds and 16.5-ft seas. Her 0600 report on the 29th was a roaring 60-kt northerly wind, with 14.5-ft seas and 19.5-ft swells. It was not until after 1800 on the 30th, beyond 31°W, that the winds dropped below 45 kt. A French vessel south of Cork, Ireland, reported 40-kt gales. The LOW was now moving southeastward through the North Sea. At 1200 on the 30th, it moved inland and dissipated over central Europe.

Casualties--The 887-ton Greek freighter KONDOR and the 10,931-ton Portuguese motorship H. CAPELOS collided in thick fog in the English Channel. This was a David and Goliath contest, but this time David lost. The KONDOR sank, with the loss of 10 of her 12-man crew. The H. CAPELOS was listing 12 degrees. Another collision occurred in heavy weather at Palermo on the 24th. The 12,869-ton CONCA D'ORO and LINDA 1 were involved.

The Greek ferry ATHENS (586 tons) took a list during ballasting of tanks in heavy weather, and capsized and sank about 5 mi north of Andros Island on the 16th. One crew member died, and two were missing. The 533-ton Irish ARKLOW BAY sank in heavy seas on the 22d, in the Irish Sea. The Dutch LELIEGRACHT (1,128 tons) capsized and sank in the North Sea. Three crew members died, and two were missing.

SMOOTH LOG, OCTOBER 1973--As could be expected in a transitional month, the storm tracks were diffuse. According to climatology, the primary track should extend from near Belle Isle northeastward, south of Iceland to the northern shore of Norway. There are several secondary tracks: one off the United States east coast, one south of the primary track south of Iceland, and one in the Mediterranean Sea. The actual primary storm track originated off Nova Scotia, south of Newfoundland, and tracked north-northeastward through the Denmark Strait. The tracks across

the northern United States and Canada were very diffuse, with no favorite path or direction except easterly. Two storms wandered around the Sargasso Sea, north of Puerto Rico. Three LOWs formed and wandered about in the area between the Azores and Spain prior to moving northward. Also, three storms made the Mediterranean Sea their home.

The pressure pattern did not have any outstanding features. It closely paralleled the climatological pattern. The Azores High was normally located, and the 1020-mb center was the same as climatology. The Icelandic Low was near 58°N, 43°W, approximately 600 mi southwest of its normal location, and 4 mb higher in pressure at 1006 mb. A trough off Newfoundland reflected the location of the primary storm track. The eastern Atlantic had higher than normal pressures. Also, a high-pressure center was located over northern Greenland. The eastern half of the United States was normal.

The large anomalies were positive this month. The largest was 12 mb over Greenland, which connected with a 10-mb center near 59°N, 14°W, between Iceland and Scotland. The eastern two-thirds of the Mediterranean was 1 to 2 mb below normal. The only area of negative anomalies was a large area off the east coast of North America.

There were two tropical cyclones this month--hurricane Fran and tropical storm Gilda. They are described in the annual article, "North Atlantic Tropical Cyclones, 1973," on page 8 of the January 1973 issue of the Mariners Weather Log. Normally, October produces two tropical cyclones, one of which will develop to hurricane intensity.

An anemic 1012-mb wave developed on a cold front just west of Lake Michigan on the 4th. It moved eastward, slowly deepening until, on the 6th, it was a 990-mb LOW over Anticosta Island. At 1200, the drilling rig VGBZ reported 50-kt winds in the Gulf of St. Lawrence. The ALERT, south of Newfoundland, experienced 35-kt gales. Twenty-four hours later, at 1200 on the 7th, the VGBZ had roaring 65-kt winds from the northwest. The seas were 18 ft. To the south, the ALERT now was buffeted by 45-kt gales.

As the LOW moved over St. John's, it filled slightly and the gradient weakened. Forty-knot winds in the northern quadrant were the strongest plotted. At 0000 on the 9th, near 43.6°N, 43.8°W, the ZCEJ found 45-kt gales about 600 mi south of the LOW's center. Thirty-five- and forty-knot winds continued to blow all around the center.

On the 10th and 11th, the LOW again intensified and executed a loop in the vicinity of 50°N, 40°W. The ALBATROS, near 46°N, 43.6°W, was headed into 45-kt gales, and the VC8062, at 47°N, 48.7°W, was pounded by 50-kt winds and 30-ft swells from the north. As the storm continued its loop, the gradient on the northwest side remained very tight, and 35- to 40-kt winds were common.

On the 11th, hurricane Fran passed south of the center. At 1200 on the 11th, Fran was near 40°N, 34°W, while the LOW was near 51°N, 43°W. The MOORDRECHT, off the Labrador coast, was fighting 40-kt winds, 16-ft seas, and 26-ft swells. High seas were reported all around the center. The AMERICAN ARCHER, about 300 mi southeast of the center, was hit by 45-kt gales and 18-ft seas.

As Fran moved to the northeast and east of the LOW, the LOW started an easterly track behind the former hurricane. The pressure was now rising again, and only minimal gale-force winds were reported. It was not until the LOW neared the continent on the 15th that it partially regained its strength. The BALD EAGLE reported that the searchlight door burst open due to heavy weather and flooded the port tunnel. The SL181, north of the Azores, found 40-kt gales. The H. R. MACMILLAN and Ocean Station Vessel "K" had 35-kt winds and seas to 15 ft. At 1200 on the 16th, after passing over Brest, a ship had 45-kt winds in the Bay of Biscay. The CHERTAL, near 51°N, 12.5°W, had 40-kt winds on her starboard side. The LOW now passed over the Low Countries and into eastern Europe.

This short-lived storm started out as a tropical depression, on the 10th, in the wake of hurricane Fran. At that time, it was located at about 24°N, 70°W, at 1009 mb. The trough became sharper as the LOW moved toward the northeast, but only developing slightly. At 0000 on the 12th, the 1006-mb center was near 30°N, 61°W. Twelve hours later, frontogenesis was indicated with a new center to the northeast. Northwest of the center, near 37.5°N, 59.3°W, the DJVO was bucking 50-kt headwinds, as was the HILVERSUM with 35 kt. On the opposite side of the LOW, the NIENBERG and SOLON TURMAN found 35-kt gales from the southwest.

On the 13th, the northeasternmost LOW broke away and sped off toward the northeast. The original depression wandered in the same area, forming a loop with its track. By the 14th, it was squeezed out of existence by two large HIGHs.

As the second LOW sped to the northeast, it treated the VARNA to 35-kt gales on the 13th, near 38°N, 39°W. On the 14th, Ocean Station Vessel "K" was not slighted, as she had 40-kt gales and 16-ft seas.

A large low-pressure area moved out of the Great Lakes and north into the Davis Strait. A trough stretched south through the Labrador Sea and across Newfoundland. South of Newfoundland, on the 19th, a small 1012-mb LOW developed in the trough. The LOW was a quick developer, as it traveled to 52°N, 46°W in 24 hr and the pressure plunged to 976 mb. The ATLANTIC CINDERELLA had a preliminary taste of the small, intense storm, at 1200 on the 20th, near 49.5°N, 44.5°W, with 40-kt winds. The tightly wound circulation continued northeastward at about 30 kt. At 0000 on the 21st, the VASSILII SOURIKOV passed almost through the center and reported 35-kt winds at that time. Ocean Station Vessel "C," in the southeast quadrant, also measured 35-kt winds. At 1200 that day, the AMERICAN ACE, about 400 mi south of the center, raced against 40-kt winds in 18-ft seas and 20-ft swells.

At 1200 on the 22d, the 978-mb LOW moved over the western tip of Iceland, and the EDITH NIELSEN, near 62°N, 20°W, was hounded by 45-kt gales. The LOW continued its headlong plunge northeastward into the Greenland Sea and to the Svalbard Islands on the 24th.

This storm was multinational, as it moved eastward along the United States and Canadian border, finally moving to sea over Cape Cod late on the 20th. At

that time, the central pressure was only 1013 mb. Development came later, after it was over open water and the Gulf Stream.

At 1200 on the 22d, the 994-mb LOW was east of St. John's, near 46°N, 46°W. Ocean Station Vessel "C" measured southwesterly 64-kt winds at 1500. The seas were 37.5 ft. Twenty-four hours later, at 1200 on the 23d, the 972-mb LOW was near 56°N, 38°W. The QUEENSGARTH, at 56°N, 40°W, had a rough go of it, with 20-ft seas and 20-ft swells driven by 45-kt north winds. The ARVIDSJAUR, on the opposite side of the center, near 55.5°N, 27°W, had 40-kt southerly gales. The AMERICAN ACE and the AMERICAN ARCHER were on the receiving end of 45- and 50-kt winds and 16.5-ft seas. They were southwest and southeast of the cyclone's center, respectively.

The storm was following nearly the same track as the previous storm. This is reasonable if no major change has occurred in the long-wave upper air pattern. At 0000 on the 24th, the 966-mb LOW was at 61.5°N, 33.5°W. The KRAS and SVENDBORG, 110 and 70 mi south of the storm, respectively, were both mauled by 45-kt winds and seas to 25 ft. As the storm passed into the Denmark Strait, Ocean Station Vessel "A" was bounced about by 40-kt winds and 25-ft seas, while maintaining her station.

As the LOW passed through the Denmark Strait, it appeared that the squeezing developed two other LOWs; one near Kap Farvel and the other in the Greenland Sea. It was like squeezing a balloon with your hand. At 1200 on the 25th, the two other LOWs had taken over the circulation and only a col area remained.

In monetary value, this storm was the worst of the month. It occurred in the Mediterranean Sea and, as far as a closed circulation was concerned, lasted less than 48 hr. Damage to Palermo and port facilities was estimated at over $200 million.

As background on this vicious storm, on the 24th, a weak front had pushed south over the mountains into Italy as high pressure moved eastward from France into central Europe. Lower pressure existed over the eastern Mediterranean. On the 0000 chart of the 25th, the front could no longer be supported, but a slight inverted trough which was present on the 24th intensified on the 25th to a 1009-mb LOW, south of the toe of Italy. Only 10- to 20-kt winds were reported at that time. On the 0600 chart, Naples reported 35-kt gales, but all other reports were average. By 1200 on the 25th, the LOW had deepened to 1004 mb and remained essentially stationary. The HIGH to the north was drifting southeastward very slowly. The 1200 and 1800 charts did not indicate anything abnormal. The LOW had dropped to 1002 mb by 1800. A 30-kt onshore wind was measured at Tunis and 25-kt at Livorno. A circulation out of the northeast had been blowing across the Tyrrhenian Sea for several days.

The storm struck the night of the 25th and morning of the 26th. Rainfall was reported for 24 hr. The 0000 chart of the 26th indicated 50-kt northeasterly winds at Palermo, but other reports referred to hurricane-force (64 kt or more) winds. Thunderstorms with hail were reported in the area, and the violent winds were probably associated with these.

By 1200 on the 26th, the center of the LOW had moved westward to near the northeast tip of Tunisia. The central pressure was 1003 mb. By 0000 on the 27th, the closed circulation had broken down, and only an inverted trough remained as before.

First reports indicated nine ships were sunk. The CONCA D'ORO was aground, the 8,177-ton Bulgarian freighter GOTZE DELCHEV sank in a floating dock. Other ships that broke moorings and went aground or were otherwise damaged were the NOTO, DAWN GRANDEUR, ZOYA, and the AMMOGAS. Two 50,000-ton and one 19,000-ton drydocks were adrift or grounded. One contained the 54,908-ton TEXACO WESTMINSTER when it broke adrift and grounded in force 9 winds. The ship was knocked off its blocks, and the bottom extensively damaged. The drydock containing the 13,731-ton Norwegian FERNGULF also broke its moorings and went aground. Many small boats were damaged or destroyed.

The waves smashed some 2,000 ft of seawall, and jetties and breakwaters were crumbled. The wind and seas uprooted trees and flooded streets as 24 hr of continuous rain contributed to the high water. Communication and electric powerlines were broken.

This LOW developed early on the 24th, off the coast of Portugal, on a front that had moved across the Atlantic and nearly stalled as it stretched southward between two HIGHs. The KANAGAWA MARU, at 47°N, 20°W, approximately 180 mi north of the 1013-mb center, was hit by 40-kt gales. The LOW was squeezed southward by the two high-pressure areas. At 1200 on the 28th, the VELIKIYE LUKI found 40-kt winds and 26-ft swells northwest of the center.

At 0000 on the 29th, the LOW was near 40°N, 20°W, as the western HIGH moved north of the LOW and across Ireland, in response to pressures exerted by extratropical Gilda. As the HIGH moved eastward, the LOW deepened to 1003-mb on the 30th and moved in a northerly direction. Although the central pressure dropped, the gradient relaxed, and strong winds and high waves were no longer being reported. As the LOW moved north, it lost its individuality as it was absorbed in the large-scale cyclonic circulation.

Monster of the Month--Extratropical Gilda--Gilda was the type of storm that makes meteorology interesting and forecasters prematurely gray or pull their hair out. After dilly-dallying in the Bahamas, she started moving northeastward, and this is when she really developed. By 1800 on the 27th, Gilda was near 43.5°N, 59°W, and extratropical. Gale-force winds were reported in all quadrants of the storm on the 27th. Among the ships reporting were the AMERICAN ALLIANCE, ATLANTIC CHAMPAGNE, OSWEGO UNITY, and SEDCO I. The LOW was speeding northeastward at 33 kt, and the central pressure was still dropping. By 1200 on the 28th, the storm was centered at 51.3°N, 48.3°W. At 0000, the NORTHERN SHELL, near 42.5°N, 54°W, struggled with 50-kt winds about 120 mi from the center. Gale-force winds were reported as far as 550 mi from the center. The VC8062 was hammered by 26-ft seas. At 1200, the C. P. VOYAGEUR was walloped by 55-kt portside winds and KIDRIC B was mauled by 50-kt winds and 23-ft seas. Both were northeast of the storm center.

The storm reached its maximum on the 29th, with a pressure of 966 mb. At 0000 it was located near 57.6°N, 43°W The C. P. VOYAGEUR, at 53.4°N,

37.7°W, which was about 280 mi southeast of the center, was ravaged by 75-kt hurricane-force winds from 190°. I would suspect that if someone asked how you handled a ship in such a situation, the reply would be "Very carefully." From subsequent plots the VOYAGEUR was headed westward, but for this period of time she appeared to be almost stopped. Kap Farvel reported 50-kt winds and snow. Ocean Station Vessel "B" and two other ships in the Labrador Sea had 45-kt gales. The DUKESGARTH was engulfed by 28-ft seas, near 51.3°N, 44.4°W, about 300 mi due south of the center.

At 1200 that day, the torrent was still raging. The KRAS, near 55°N, 51°W, was headed west toward Hamilton Inlet and being mauled by 65-kt northwest winds ("wind" hardly seems a strong enough term) and 30-ft seas. In the past 24 hr, she had steamed from one side of the storm to the other, almost through the center; from 50-kt southerly winds to 65-kt northwesterly. The NANOK S, about 180 mi east of the center, which was 70 mi southeast of Kap Farvel, was heading into 60-kt southerly winds and 33-ft waves. Twelve hours later, the winds had calmed to 45 kt, with 20-ft seas topping 26-ft swells. Ocean Station Vessel "A" was suffering 40-kt winds and 30-ft seas. Gale-force winds extended 750 mi south of the center.

On the 31st, the storm was filling rapidly and stalled near 65°N, 37°W, over the cold water of the Denmark Strait.

Casualties--The 15,028-ton MARATHONIAN and the Norwegian ROLWY (21,274 tons) collided head-on in dense fog on the night of October 2, in the Mackinac Straits. There were no injuries, but both ships had to enter drydock facilities for repairs.

Fog was again the culprit in the collision of the 22,248-ton Norwegian bulk carrier SNEHOLT and a small West German coastal vessel early in the month. The coastal vessel capsized, but remained afloat. Six of the crew were rescued, but the master was reported missing.

There is no indication that weather was involved, but a real-life "Poseidon Adventure" happened when the French dredger CAP DE LA HAGUE capsized off Calais. French Navy divers rescued one man from the overturned dredge, but six others were not rescued. In another capsizing, the last week in the month, rough seas overturned a trawler which sank off the Devon Coast. A 13-yr-old boy was trapped inside. Frogmen tried to rescue him, but there were no air pockets, as the ship landed upright on the bottom. Four men swam in the sea for 30 min before being rescued by a fishing vessel.

The 9,041-ton Turkish FIRAT sustained heavy weather damage on the 15th. Heavy lifts broke stowage in upper 'tween decks. On the 18th, the dredger PITTSBURG broke tow with the tug GWYNEDD in weather off Cape Hatteras. The dredger sank, and an oil barge was recovered. There were no injuries. The Finnish 1,347-ton CERES sank in the Gulf of Bothnia during a gale, after deck cargo shifted. The 1,019-ton Jamaican DOMBURGH ran aground in heavy seas off St. Augustine, Fla.

Smooth Log, North Pacific Weather

September and October 1973

SMOOTH LOG, SEPTEMBER 1973--The first part of the month, the extratropical cyclone activity was below normal in number, but greater in size and intensity. During the last part, the cyclone activity was normal or slightly above normal, resulting in near-normal activity for September. The tracks followed the climatological pattern, in general, with two exceptions. The first was a secondary track from Japan to the Gulf of Alaska, which was south of the primary along the Aleutians. The second exception was a series of tracks during the middle of the month. The average path of these storms was between 40° and 45°N, toward the northern west coast of the United States.

The mean pressure pattern was also normal, with no major extremes. The 1022-mb Pacific High was only 1 mb higher than climatology, but had three subcenters, two of them further west than the primary center. The center of the 1005-mb Aleutian Low was 2 mb lower than the 1007-mb climatic center and collocated. The trough was sharper and slightly deeper. A small high-pressure center was located near Calgary, Alberta.

As in the Atlantic, when the data are near normal, there are no large anomalies. Again, in the Pacific, the largest anomalies were 4 mb. Two negative 4-mb anomaly centers were located south of Alaska along 50°N. The zero anomaly line approximately paralleled 40°N latitude across the entire Pacific. The area south to about 20°N latitude was positive, with several 4-mb centers along 30°N.

Tropical cyclone activity usually starts to decrease during September, from a maximum in August. Climatic records indicate that the western Pacific averages almost five tropical storms, and over three will become typhoons. In the eastern Pacific, mariners can expect three tropical storms, and about half will reach hurricane intensity. This month, there were two typhoons, Louise and Marge, in the western ocean, and in the eastern ocean, two hurricanes, Irah and Katherine, plus one tropical storm, Jennifer. The eastern North Pacific tropical cyclones are described in the article appearing on page 78 of this issue.

This 1010-mb LOW had its start in the Sea of Japan, at 0000 on the 3d. As it moved across northern Japan, it slowly deepened. The storm was under the influence of the upper air zonal flow, and its pace was steady as it moved across the North Pacific at about 30 kt. By 1200 on the 5th, the 996-mb LOW was near 47.5°N, 172°E. It was not until 1200 on the 6th that it developed significant winds. The LOW was near 54°N, 167°W,

over the Aleutians. The THOMAS E. CUFFE, 800 mi to the south along the front, was hit by 40-kt gales. The seas had picked up to 16 ft.

The storm's center moved up the Aleutian Island chain, and, at 0000 on the 7th, three ships reported 35-kt gales in the vicinity of the triple point, but only the HOTAKA MARU was identifiable. The VAN FORT, to the west at 51.8°N, 159.5°W, measured only 41-kt winds, but was swept by 36-ft seas.

On the 8th, the storm moved south of Kodiak Island. The IRISH STARDUST, at 50°N, 157.5°W, found winds of 45 kt about 400 mi south of the center. The CHEVRON CALIFORNIA, at 52.8°N, 152.4°W, was wrestling with 50-kt winds and 20-ft seas. Later in the day, the G. B. REED, just off Vancouver Island, was fighting 35-kt southerly winds. The storm occupied all of the Gulf of Alaska, but was beginning to deteriorate rapidly as a HIGH moved eastward.

This LOW formed on the same front as the previously described LOW, over Kyushu, Japan, on the 6th. The incipient wave passed south of Tokyo on the 7th. As it moved over the Kuroshio Current, it rapidly deepened to 999 mb. The TAICO MARU, which was directly in the path of the oncoming storm, had 35-kt cross-winds. Twenty-four hours later, the 989-mb LOW was at 45.2°N, 161.3°E, and the KOYU MARU and the NELSON MARU found 40-kt winds both ahead and behind the storm. Twelve hours later, at 1200 on the 9th, the NELSON MARU was still being hit by 40-kt winds, but now out of the northwest, 180° from the previously reported direction. On the 10th, the JUZAN MARU was directly south of the center, with 40-kt gales accompanied by 23-ft seas and 26-ft swells. The VAN FORT was still having problems as she fought 44-kt winds and 32.5-ft seas, near 49.1°N, 177.3°W, late on the 10th.

This LOW also tracked up the Aleutian Island chain, but slightly on the Bering Sea side. It reached its lowest pressure of 976 mb on the 11th. From this time on, it was downhill for the LOW, as it turned northerly toward the Bering Strait and filled. At 0000 on the 12th, the PHILIPPINE MAIL and the THOMAS G. THOMPSON, west and east of the center respectively, found opposite-direction 40-kt winds. The LOW passed over Mys Chaplina on the 13th, a 998-mb nobody.

This LOW was the grandmother of the LOW that produced the highest winds plotted on the weather charts for the North Pacific this month. How about that as a distinction? On the 8th, a frontal wave formed in the East China Sea. It moved northeastward through the Sea of Japan and the frontal wave occluded. At 1200 on the 11th, a new 998-mb LOW formed at the triple point which was now northeast of Hokkaido.

This new LOW crossed the Kuril Islands and moved parallel to the coast of the Kamchatka Peninsula. At 1800 on the 12th, a 992-mb grandchild was born near 50°N, 168°E. By 1200 on the 14th, the LOW was near 55.5°N, 178°W, and the pressure was at its minimum of 969 mb. It was at this time that the OHMINESAN MARU, near 59°N, 176°W, was whipped by 60-kt winds and heavy rain. The USCGC BURTON ISLAND was north of Unimak Island and had 40-kt gales with thunderstorms and lightning. The CHALMETTE measured 50-kt storm winds at 51.5°N, 164.3°W, on the 15th. Gale-force winds were reported all along the island chain. Late on the 16th, the LOW stalled south of Nunivak Island and lost its identity.

As it is with most storms in the North Pacific, this one originated south of Kyushu, Japan, on the 13th. It was not until about 1200 on the 14th that it concerned anyone. At that time, the DAISHOWA MARU, very near the center at 40°N, 148°E, had very heavy rain and 40-kt winds.

The 15th was the big day for the 984-mb LOW. The VAN FORT seemed to be running from one storm into another, as this one handed her 49-kt gales. The EASTERN BUILDER, at 44.7°N, 159.2°E, measured 50-kt winds from the north, with 15-ft seas and 25-ft swells, and another ship, south of the center, had 50-kt westerlies and 40-kt, 12 hr later.

As the LOW sped eastward, it treated the SPERO to 50-kt winds at 1800 on the 16th. On the 19th, the OSWEGO PATRIOT felt the sting of 41-kt gales. Late on the 20th, the storm grounded on Vancouver Island.

This small frontal wave, which developed south of Shikoku, Japan, on the 18th, originally could have almost been a figment of the analyst's imagination or a bump of his arm. A few hours later, though, there was no doubt of its reality as it developed and sped eastward. On the 19th and early on the 20th, ships were finding minimal gale-force winds east of Tokyo. At 1200 on the 20th, the 1000-mb LOW was near 39.2°N, 168.3°E. About 300 mi south, the IVAN KOTLYAREVSKIY was headed west fighting a 45-kt wind on her bow.

On the 21st, the LOW, now 984 mb, was moving over and being nurtured by the Kuroshio Extension Current. It was also under the influence of the long-wave zonal flow. Northwest of the center, near 44°N, 175.5°E, the OYO MARU was churned by 40-kt north-northeasterly winds and 20-ft easterly swells. To the south, the GLOMAR CHALLENGER also found 40-kt winds from the southwest, but calmer seas. The VOLNAY was not so lucky, as the winds were not calmer. She measured 60-kt easterly winds just northeast of the storm center. The storm then turned northeastward and, at 0000 on the 22d, the DELTA DRECHT combated 50-kt southeasterly winds and 20-ft swells on her easterly course. Twelve hours later, the storm was at its lowest pressure and tightest gradient. The SONETTE was headed eastward along with the storm. On the 21st, she reported 50-kt winds. On the 22d, as the storm passed north of her position, the winds were 44 kt and the seas had built to 39 ft. At 0000 on the 23d, the winds were 55-kt, with the seas still 39 ft.

As the LOW moved into the Gulf of Alaska, it passed directly over Ocean Station Vessel "P," about 0800 on the 23d. It was losing some of its strength, and the maximum winds plotted were 35 kt. Late on the 24th, it moved onto the State of Washington coast.

This storm was another of those that develop from a combination of LOWs. One moved out of China, across the Yellow Sea and Korea, and was in the Sea of Japan on the 26th and 27th. Vladivostok experienced 35- to 40-kt winds for over 24 hr.

Another LOW had developed south of Japan and appeared to be headed eastward, but on the 25th turned

toward the north. It was treating ships to 35-kt gales on its east side. At 1200 on the 28th, the two LOWs combined off the Kamchatka Peninsula. The SHIKISHIMA MARU, in the Bering Sea, was hit by 35-kt gales. By 0000 on the 29th, the pressure had fallen to 982 mb off Mys Olyutorskiy. As the main center continued its northerly track toward the Bering Strait, other small LOW centers developed in the major trough. At 0000 on the 30th, the Pribilof Islands were whipped by 40-kt winds. The MONTIRON, north of Dutch Harbor, was rolled by 45-kt winds and 20-ft seas on her port side. South of Adak Island, the JAPAN ERICA was washed by heavy rain and 35-kt winds. As the 978-mb LOW moved into the Chuckchi Sea on October 1, a weather station on Mys Navarin was beaten by 50-kt winds. Uelen, on the Bering Strait, suffered 40-kt northwest winds and snow. The LOW continued into the Beaufort Sea and finally turned southeast into the Northwest Territories of Canada.

Louise popped up as a tropical storm in the Luzon Strait on the 3d. She meandered westward and climbed to typhoon strength on the 5th, near 20°N, 115°E. Louise was heading for Hai-nan. Before reaching the island, maximum winds near her center climbed to 80 kt, occasionally gusting to 100 kt. Louise weakened as she crossed the northern part of Hai-nan. She entered the Gulf of Tonkin as a tropical storm. On the 7th, she crossed the Gulf and made landfall over North Vietnam, just north of the 20th parallel.

Five days later, Marge came along, just west of the Lingayen Gulf in the South China Sea. Like a bear seeking honey, Marge headed toward Hai-nan. She reached typhoon strength on the 13th, as her winds climbed to 85 kt. Gales extended out about 100 mi. She crossed the Hai-nan coast that same day. The island took its toll, and Marge dropped to tropical storm strength shortly after emerging into the Gulf of Tonkin. She crossed the North Vietnam coast near 20°N late on the 14th.

Casualties--The 1,569-ton Japanese freighter TOYOICHI MARU capsized and sank off northern Taiwan on the 29th, after being hit by high waves. The captain and three crewmen are missing. Seventeen other seamen managed to swim ashore.

One of two men who survived 72 days at sea, clinging to the overturned trimaran TRITON, died October 2. The trimaran capsized on July 11 in a gale, while enroute to Costa Rica from Tacoma, Washington. They were rescued by the British containership BENALDER (57,887 tons), on September 21, 900 mi southwest of San Francisco. The wife of the surviving man died 30 days after capsizing. They survived on canned sardines, peanut butter, and rainwater.

SMOOTH LOG, OCTOBER 1973--Cyclone activity for the month was above normal. The general pattern closely resembled the climatological pattern, but there were a few significant differences. According to climatology, the major storm tracks come out of the west, over Sakhalin Island and southeast of Japan, toward the Near Islands, and into the Bering Sea. The major track then moves along the Aleutian Islands in the Gulf of Alaska, with a secondary track into the Bering Strait. Another primary track is located from the central ocean into the southern part of the Gulf of Alaska.

This month there were fewer storms out of the Sea of Okhotsk, but more from the area off Japan. The average path of these storms crossed the Aleutians east of the Near Islands and continued through the Bering Sea toward Alaska's west coast, thus the secondary track became the primary this month. Several cyclones formed in the central Pacific between 30° and 40°N, but in general dissipated prior to reaching the Gulf of Alaska or the North American west coast.

The Aleutian Low had two centers. The main one of 1000 mb was centered in the Gulf of Alaska, near 58°N, 147°W; the other was a 1009-mb center in the Sea of Okhotsk. The 1002-mb climatic Aleutian Low was located over Cape Newenham, Alaska. The 1019.8-mb Pacific High was approximately 2 mb higher, at 1022-mb pressure, and about 600 mi further west, near 34°N, 153°W. It also bulged farther to the north and northwest. This bulge resulted in the largest anomaly, a positive 9 mb, located near 50°N, 170°W. The two separate low centers were associated with a negative 6-mb anomaly in the Gulf of Alaska, near Yakutat, and a negative 3-mb center in the northwestern Sea of Okhotsk.

There were five tropical cyclones in the Pacific this month: hurricane Lillian in the eastern North Pacific, and typhoons Nora, Opal, Patsy, and Ruth in the western North Pacific. Climatological data indicated that two tropical storms, with one reaching hurricane intensity, can be expected in the east, and slightly less than four tropical storms, with almost three becoming typhoons in the west. The article, "Eastern North Pacific Tropical Cyclones, 1973," describing those storms, begins on page 78 of this issue.

The first week of the month, the North Pacific was dominated by a large HIGH over the central ocean, with a central pressure as high as 1044 mb. LOWs were confined to the sides of this large mountain of air. The formation of one of these LOWs was indicated on the 0000 chart of the 3d, by the 30-kt report of the HANYANG, near 33°N, 170°W. A 1014-mb LOW had formed near 32°N, 166°W. A weak cold front, which lay between the central Pacific HIGH and a 1034-mb HIGH off the U.S. west coast, was drawn into the LOW's circulation by 1200. Twenty-four hours later, the LOW had developed a good circulation, as a wave formed on the front.

Northwest of the center, the WAARDRECHT was being hammered on her starboard side by 45-kt winds, 16-ft seas, and 20-ft swells. The LOW was moving northeastward, but not for long. Late on the 4th, its path began to curve northward, then northwestward, as a cutoff LOW developed in the upper atmosphere. At 0000 on the 5th, the 500-mb upper air LOW was centered at 34°N, 162°W, and the surface 998-mb LOW was at 36°N, 162°W. Two ships on the north and northwest side of the LOW, which was pressing hard against the large 1037-mb HIGH, found 55-kt winds, 10- to 12-ft seas, and 21- to 30-ft swells. They were the AMERICAN CORSAIR, near 39.9°N, 163°W, and the ROBERTS BANK, near 41.4°N, 159.8°W.

On the 6th, the LOW had curved further toward the southwest as it followed the upper-air circulation.

The strongest winds now being reported were 30 kt. The HIGH was breaking down and moving eastward, north of the southwestward-moving LOW. At 0000 on the 7th, the HOEGH ELAN was nearly in the center of the storm and being buffeted by 45-kt gales.

On the 8th, the storm was closing the circle and again moving northeastward, as the upper-air flow adjusted and the cutoff LOW dissipated. The surface LOW was filling as it lost its support and was surrounded on three sides by HIGHs. By the 0000 chart of the 10th, the LOW could no longer be identified.

This was a fast moving storm. It formed due east of Tokyo, as a wave on a front, on the 7th. This part of the front was located under the eastern side of an upper-air trough. As the previously referred to cutoff LOW broke down, the upper-air trough started moving eastward. Under this influence, the surface LOW developed rapidly. By 0000 on the 8th, the LOW had a 998-mb pressure and was at 39°N, 154°W. At 0000 on the 9th, it was near 47°N, 168°E, and 985 mb. Gale winds were blowing in the southern half. The HARUNA MARU and the HONG KONG MAIL both found 35-kt winds. The GEORGIANA, at 40°N, 177.4°E, found 42-kt gales, and the KINYO MARU, at 46.1°N, 174.2°E, measured 45-kt gales. The LIECHTENSTEIN measured howling 50-kt storm winds northeast of the center, 12 hr later.

Twenty-four hours later, the center had raced to 55.5°N, 175°W, and the pressure was only 964 mb, deeper than some typhoons. The storm's forward speed had averaged over 30 kt, higher than most of the winds reported. The EASTERN BUILDER was 500 mi to the south, and really having a bad trip against 45-kt west winds, 20-ft seas, and 46-ft swells. At 1200 on the 10th, as the LOW moved toward Bristol Bay, the SANJIN MARU struggled with 55-kt winds. The USCGC JARVIS, just north of the Islands of the Four Mountains, valiantly fought winds of 60 kt and seas of 30 ft. Twelve hours later, the WASHINGTON MAIL, south of the Alaska Peninsula, was in the 45-kt wind band. As the LOW moved across the peninsula into Cook Inlet, it split into two centers and then rapidly filled. The SWZL was still able to report 40-kt winds. The LOW remained in the Gulf of Alaska for 36 hr more, then was absorbed by another LOW, which had been following and moved around its periphery when it stalled.

This was another export from Japan. They were glad to see it go, as the dual wave system dropped heavy rain on most of the islands, particularly the northern ones. The southern wave is the one of concern here. It departed Nagoya on the 13th, at 1002 mb. As it moved eastward, the northern wave moved northward. The associated front was nearly north-south oriented as a 1040-mb HIGH, centered just south of the Aleutians, held back its easterly movement. The wave moved northward along the front. At 1200 on the 15th, it was located near 44°N, 159°E. Between the front and the HIGH, the CHIKUZEN MARU had a breezy 35-kt.

On the 16th, the HIGH moved southeastward, and the LOW started curving eastward over the top and developing. The CALIFORNIA, far to the south and west of the cold front, had 50-kt winds. By the 17th, it was over the Bering Strait. Usually this is the burial ground, but the cold weather rejuvenated this system. At 0000, the pressure had dropped to 984 mb. By 1200, the storm was 975 mb and moving southeastward across the Alaska Range. The HASHIMA MARU, at 57.5°N, 165°W, was hit by 50-kt gales, 25-ft seas, and 25-ft swells. On the 18th, the LOW was in the Gulf of Alaska, and the CHALMETTE, at 52°N, 162°W, was also slashed by those 50-kt winds and 26-ft seas. Not far away, the HOTAKA MARU was having 40-kt gales. The storm stalled on the 18th, near 57°N, 147°W, north of EB03. It was reporting 35-kt winds, as were half a dozen ships. At 1200 on the 19th, the NEVADA STANDARD, at 49.6°N, 134.3°W, found herself involved with 50-kt winds. To the west, Ocean Station Vessel "P" was concerned with 35-ft seas. The storm was persistent, but weakening. The USCGC JARVIS, south of Kodiak Island, was inspecting 45-kt gales and swells of 33 ft.

On the 21st, the storm began to drift southeastward, but not very far. It remained as an identifiable but impotent system until the 24th.

This storm formed at the point of occlusion of an old frontal system that came out of Asia. It found the fountain of youth over the Kuroshio Current off Japan on the 22d. Compared to other developing storms in this area, it contained high winds almost at inception. At 1200, the TOYOTA MARU No. 10 was headed southwestward into 60-kt storm winds and heavy rain, just ahead of the front.

The high-pressure areas had retreated far to the south, along approximately 30°N, so this was an easterly moving LOW. At 1200 on the 23d, the LOW was at 45°N, 176°E, with a pressure of 978 mb. A ship, the J-DJ, about 180 mi south of the center, was overtaken by 55-kt winds. Twelve hours later, the 966-mb LOW treated the ALBRIGHT EXPLORER to 50-kt winds at 44°N, 177°W. Another ship reported 40-kt winds about 90 mi northeast of the center.

At this time, a second LOW developed in the trough left behind as the original LOW moved eastward. On the 25th, the two LOWs were in trail south of the Aleutians. The younger was becoming the predominant one. On the 26th, the first LOW curved northwestward across the Alaska Peninsula and was lost in the wilds of Alaska. The new LOW was now a 978-mb circulation covering the ocean from the Canadian coast to the Kamchatka Peninsula. At 0600, the MAGELLAN MARU, near 41°N, 161.5°W, had 45-kt gales and 26-ft swells. The SILVERMAIN, at 40°N, 164°W, was whipped by 50-kt winds, 12-ft seas, and 36-ft swells. As the center moved into the Gulf of Alaska on the 27th, Ocean Station Vessel "P" measured 35-kt gales and 25-ft seas. At 1200 on the 28th, the LOW was wrecked on the rocky shore near Ketchikan, Alaska.

There were four LOWs stretched across the ocean on the 25th, from the Sea of Japan to British Columbia, when a fifth formed off Tokyo. It soon developed over the warm current off the coast. A ship off Ostrov Iturup reported 45-kt winds, north of the developing storm. The northeastward movement had been relatively slow, but it picked up as the direction turned eastward under the upper-air flow.

At 0000 on the 27th, the 1001-mb LOW was at

44.5°N, 165.5°E. The SERGUIEI ESSENINE had 40-kt southerly winds southeast of the center, and the YONEKAWA MARU fought 45-kt gales off her beam, southwest of the center. The WAY WAY, at 46.4°N, 178.1°E, was engulfed by 55-kt winds. The LOW deepened as it crossed the Subarctic Current south of the Aleutian Islands. It caught up with the PRESIDENT POLK and treated her to 45-kt winds on the 28th.

The USCGC JARVIS, on patrol along the Aleutians, was beaten by 58-kt storm winds and 25-ft seas on the 29th. Later that day at 1800, the SANTA MARIA struggled with a 60-kt by 36-ft storm. This was only a sample, though, as she was ravaged by 90-kt winds and 55-ft seas 6 hr later, at 0000 on the 30th, at 54.7°N, 145.3°W. I doubt that the original SANTA MARIA would have survived such a storm.

The LOW was now moving very slowly toward the Alaska-Yukon border, where it crashed against the unmoving mountains and the cold, unfriendly rocks.

If it weren't late October and the latitude 35°N, this could have been considered a tropical easterly wave. A 1015-mb LOW formed in an inverted trough over the Yellow Sea on the 27th. A weak, diffuse system of LOWs and HIGHs had persisted over China for several days. The system consolidated and moved across the Sea of Japan on the 28th. By 1200, it was located near Hakodate, Hokkaido, Japan, and the pressure had dropped to 991 mb. Twelve hours later, it was really winding up, and gale winds were blowing. The JUNEAU MARU, just off the Kuril Islands, was swept by 45-kt winds blowing toward the islands. Gale winds were reported as far south as 35°N. At 1200 on the 29th, the 966-mb LOW was at 48°N, 151°W. The JUNEAU MARU, near 44°N, 151°E, was now suffering 50-kt southwesterly winds. The KATHRYN MARU, at 47°N, 155°E, and the SUZUKAWA MARU, at 45.6°N, 163.5°E, were both on the receiving end of 40-kt gales. Winds of 35 to 40 kt continued in the southern half of the storm, as it crossed the Kurils near 48°N. The LOW was now on an easterly track, and the pressure was rising, as it moved under the upper-air ridge on the 31st.

At 0000 on November 1, the LOW again started to intensify. By 0000 on the 2d, it was located near 50°N, 172°W, at 992 mb. The KASHIMA MARU, in Bristol Bay, was riding out 40-kt gales. The path of the LOW was now northerly, and it entered the Bering Sea. The cold water north of the Aleutians was too much, and within 12 hr the LOW was no more.

Nora was spotted first about 200 mi northwest of Yap Island on the 2d. After meandering westward for 2 days, Nora turned northward and developed to typhoon strength on the 4th. She intensified rapidly. By the 5th, while heading west-northwestward, Nora became a supertyphoon; winds near her center reached 130 kt, with gusts to 160 kt. Early the next day, winds peaked at 150 kt, with gusts to 180 kt, and Nora was on a beeline for Luzon. She was 400 mi away, but gale-force winds were not far off. As the supertyphoon came closer to the Philippines, it weakened somewhat. However, it is believed that the northeastern Luzon coast was battered by 140-kt gusts before Nora crossed the coast on the 7th. Winds, waves, and torrential rains caused extensive damage and were responsible for at least four deaths. Part of the Arnedo Dike, about 40 mi north of Manila, gave way, putting eight towns under water. After crossing the northeast tip of Luzon, Nora continued north-northwestward toward China. She moved through the Luzon Strait and the northern South China Sea, carrying winds only slightly above typhoon force minimum. Basco, on Batan Island in the Luzon Strait, measured 55-kt winds from the southeast at 1200 on the 8th. On the 10th, Nora crossed the China coast near Shan t'on. On the 10th, the 3,724-ton Greek BALTIC KLIF sank near 22.7°N, 118.6°E. Three of the crew died, and more are missing. The ASIAN MARINER was also reported sunk during Nora, near 23.2°N, 119.4°E. The crew was rescued.

Typhoon Opal was short lived. She appeared on the 4th in the South China Sea, some 430 mi east of Saigon. Heading northwestward, she reached typhoon intensity on the 6th, near 14°N, 112°E. At this point, Opal turned her 75-kt winds westward toward the central coast of South Vietnam. She crossed the coast as a typhoon late on the 7th.

About this time, Patsy was getting organized for her journey to the already-reeling northern Luzon. Patsy was first detected on the 6th, about 150 mi west of Guam. Heading west-northwestward, she reached typhoon strength on the 8th, near 14°N, 139°E. Patsy developed steadily. Winds climbed to above 90 kt on the 9th, and reached 130 kt, with gusts to 160 kt, on the 10th. The Japanese ship JMXU encountered 45-kt winds about 70 mi south of the center, at 0000 on the 10th. Patsy's intensity diminished rapidly as she neared Luzon on the 11th. Before the day was through, she had dropped to tropical storm strength and turned northward to skirt the island. On the 12th, she turned toward the west and moved through the Babuyon Channel into the South China Sea. Patsy quickly weakened to a depression. In this stage, she traveled across the South China Sea and crossed the coast of South Vietnam near Da Nang on the 15th.

Typhoon Ruth was forming in the seas where Patsy developed as Patsy was approaching the Luzon coast on the 11th. Ruth's track was similar to, but south of, Patsy's until she reached the South China Sea. While Ruth did not become as intense as Patsy, she remained at typhoon strength from the 13th through the 18th. Her typhoon winds and torrential rains caused destruction in both the central Philippines and Hai-nan. At 0000 on the 15th, Laoag, Luzon, some 250 mi northwest of the storm's center, reported 45-kt winds. As Ruth neared Hai-nan, Hsi Sha Chou on Paracel Island reported winds from the south at 60 kt. Ruth moved on a west-northwesterly track for most of her life, cutting across central Luzon on the 15th, then turning northwestward on the 18th, to move through Hai-nan and finally into eastern North Vietnam and mainland China on the 19th. Ruth's central winds reached 70 kt on the 13th, in the Philippine Sea. After they diminished to minimum typhoon force over central Luzon, they increased to 85 kt on the 17th, in the South China Sea.

Casualties--Except for those already mentioned, the only other weather casualties involved a small ship. On the 6th, the MADELINE J. broke down 22 mi off the Oregon coast and had to be towed in by the Coast Guard. At the time, the wind was estimated by the Coast Guard at 50 to 60 kt, with gusts to 80 kt, and the seas, 15 to 20 ft.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

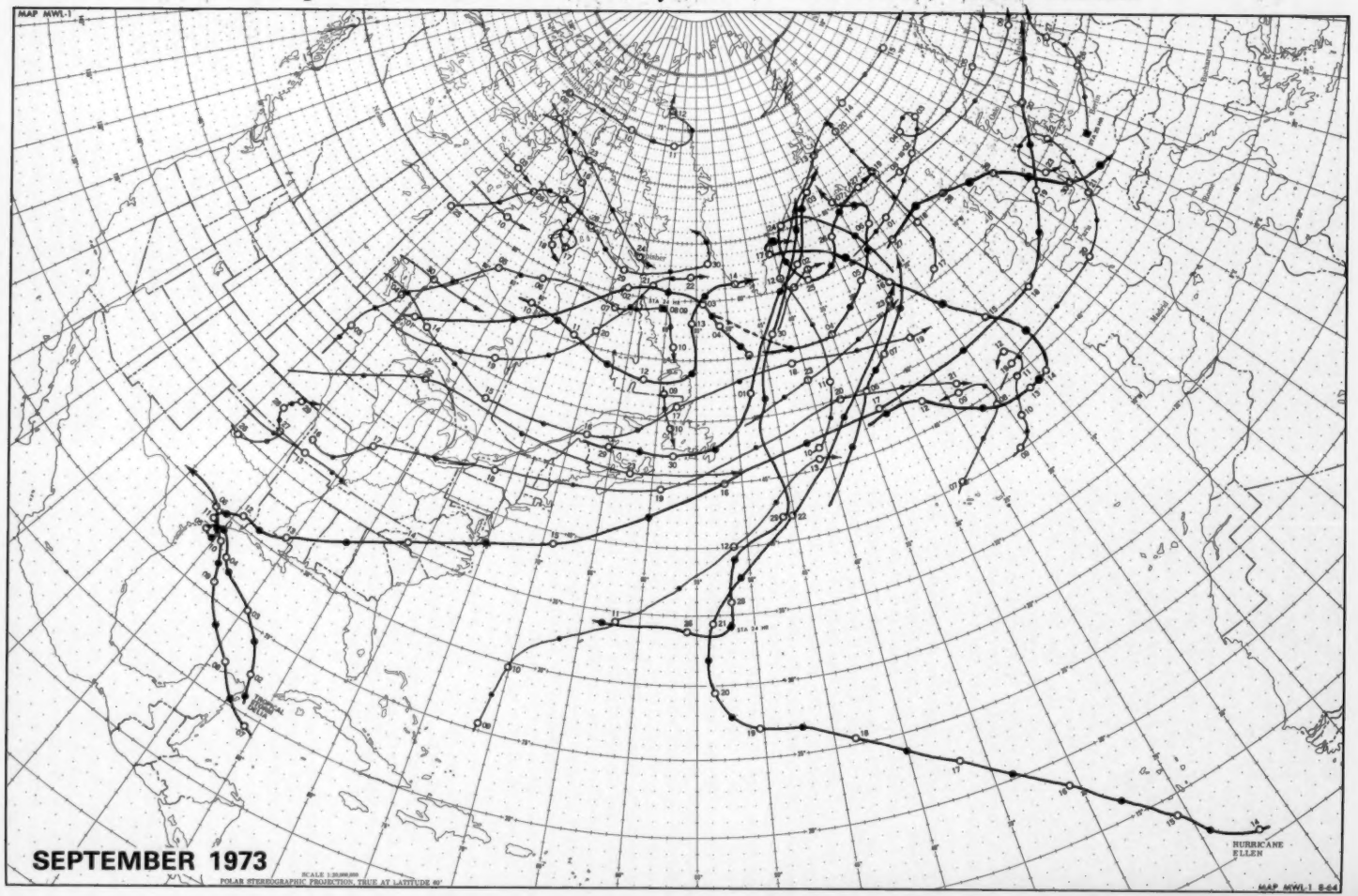

Figure 31.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

Figure 31. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

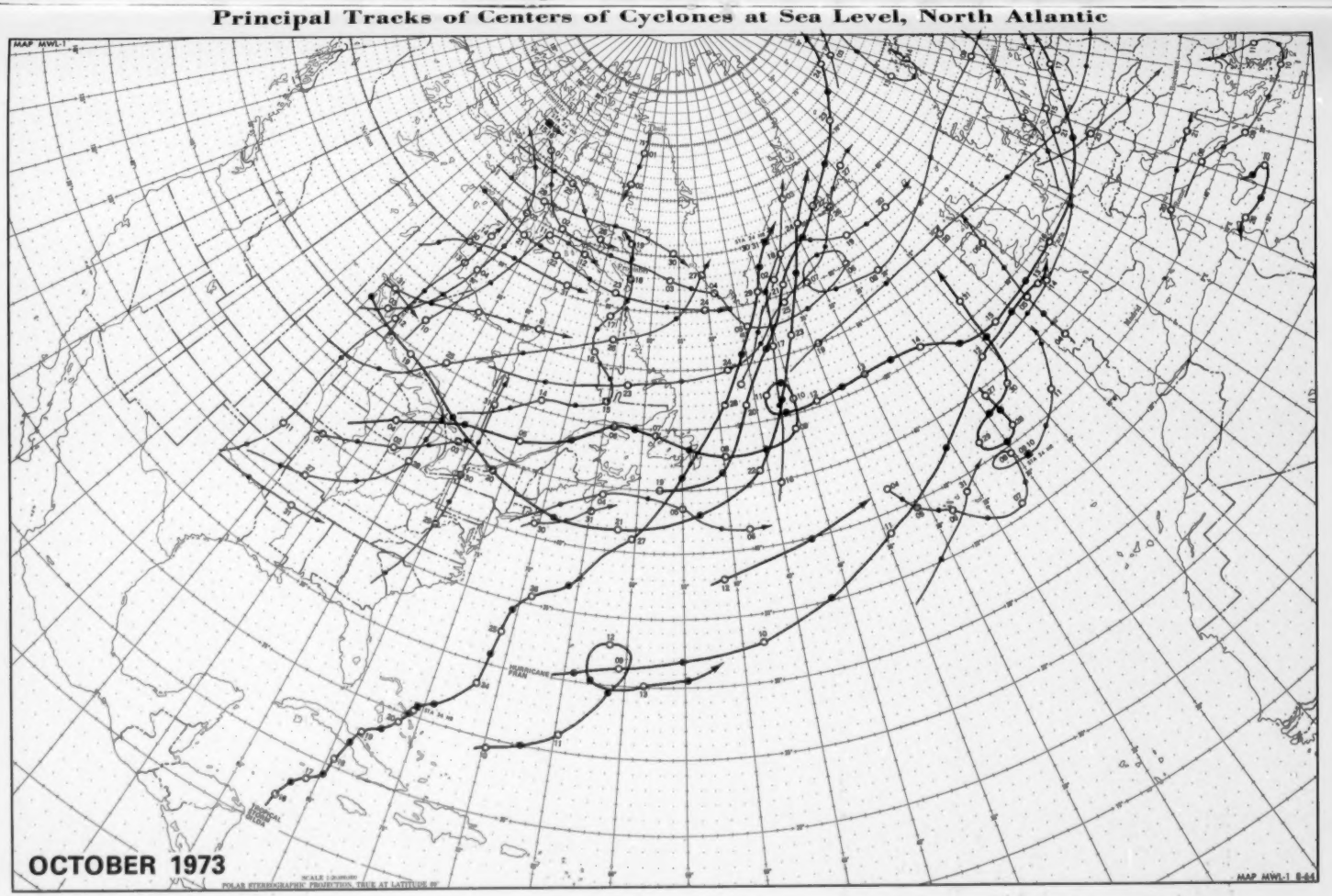
Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic
MAP MWL-1
HURRICANE FIFI
TROPICAL STORM ELLEN
OCTOBER 1973
POLAR STEREOGRAPHIC PROJECTION, TRUE AT LATITUDE 35°
MAP MWL-1 8-64

Figure 32. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

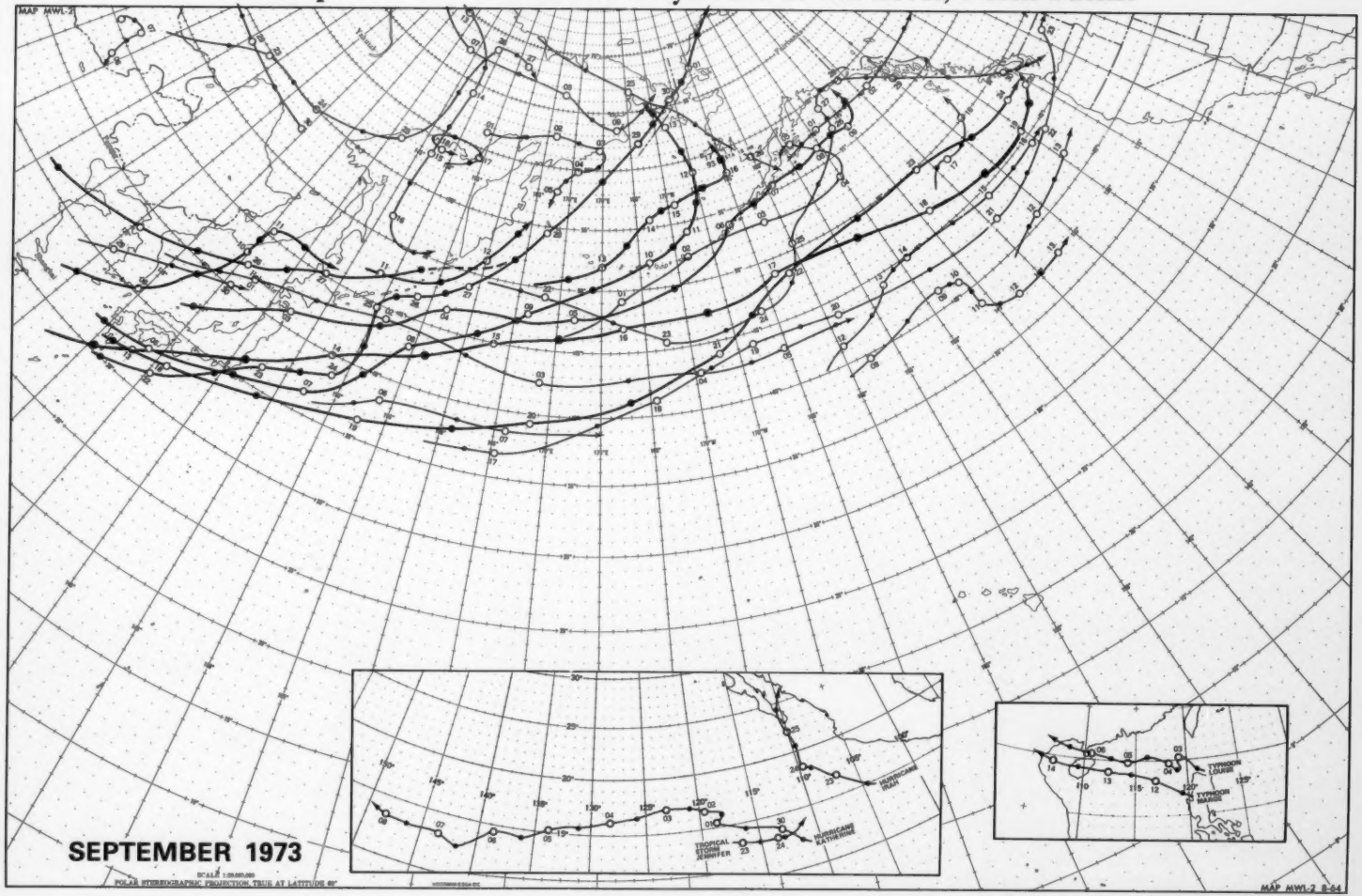

Figure 33. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

Figure 33. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

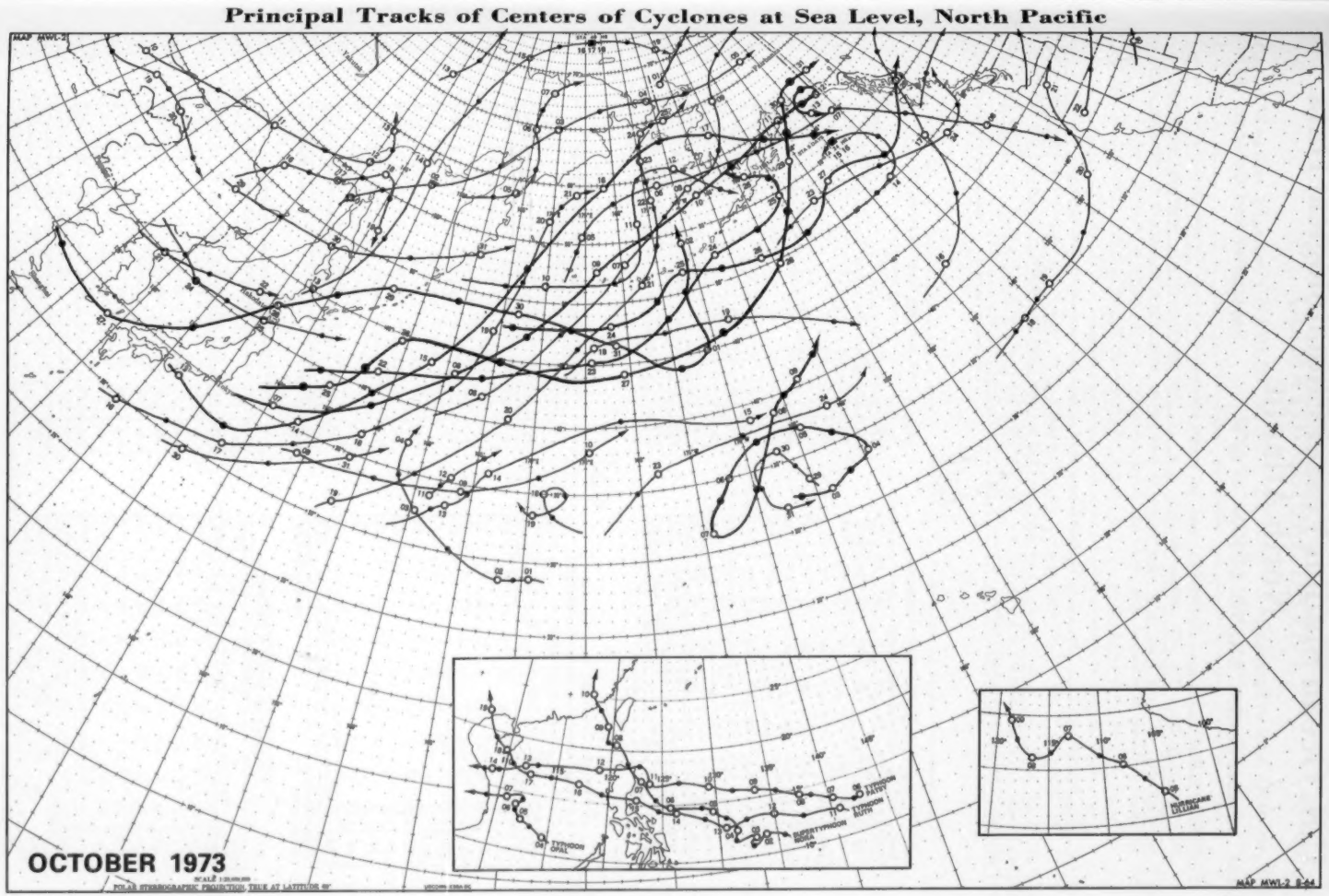

Figure 34. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 9

U.S. Ocean Station Vessel Climatological Data, North Atlantic

Ocean Weather Station 'BRAVO' 56°30'N 51°00'W **September and October, 1973**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
SEPT	4.0	22 06	8.1	12.2	09 15	- 2.6	20 09	4.8	9.4	10 12	2.8	29 00	9.0	10.9	*12 03	- 4.3	22 06	- 1.0	4.2	07 18
OCT	.0	29 12	5.1	9.5	16 15	- 5.2	23 12	1.7	7.6	13 09	3.1	29 06	6.8	10.0	12 03	- 6.7	03 21	- 1.7	1.7	*16 15

MONTH	PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR PCPN	DREL	SNOW	TSTM	VSBY <1Km **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
SEPT	987.0	03 09	1004.9	1018.2	02 09	3.8	10.9	28.2	57.1	13.4	24.4	29.4	32.8	29	23	1	0	4	6	0	0	27	18.9	238
OCT	989.5	29 00	1009.2	1027.3	09 00	2.3	18.3	34.7	44.7	9.6	26.5	37.4	26.5	26	26	7	0	1	13	3	0	29	17.8	219

** VV-90-93 AND/OR W=4 COMP OB DAYS-COMPLETE OB DAYS

Wind

SEPT WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.5	2.6	.8	.0	.0	4.7	14.8
NE	.0	1.5	.4	.4	.8	.0	3.2	18.2
E	.0	1.2	.0	.0	.0	.0	1.2	4.4
SE	.0	1.9	.8	.8	.4	.0	3.8	14.4
S	.0	1.8	12.9	9.2	.0	.0	23.9	19.3
SW	.0	3.0	3.0	3.9	.0	.0	10.0	16.8
W	.4	7.6	10.9	4.2	1.4	.0	24.5	15.9
NW	.0	3.5	7.9	10.4	4.9	.0	26.3	23.1
CALM	2.5	.0	.0	.0	.0	.0	2.5	.0
TOTAL	2.9	21.8	38.2	29.4	7.6	.0	100.0	18.3

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
238	320	42	26 1455	9.1	265	

OCT WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.0	2.7	3.0	2.2	.3	8.2	27.0
NE	.0	1.5	5.4	6.6	2.6	.0	16.1	22.4
E	.0	1.3	4.0	5.0	.0	.0	10.3	19.5
SE	.0	.5	3.0	1.5	.9	.0	5.8	21.4
S	.0	2.2	4.0	4.8	.5	.0	11.4	20.9
SW	.0	.6	7.2	8.2	.0	.0	16.0	20.6
W	.0	.8	4.0	4.2	3.8	1.0	13.8	27.7
NW	.0	1.5	4.0	7.8	4.7	.5	18.4	25.8
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	8.2	34.2	41.1	14.6	1.8	100.0	23.4

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
219	290	52	29 1200	5.0	303	

Wave

SEPT WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	4.1	4.3	.8	.0	.0	.0	.0	9.0
NE	.0	.0	1.7	.0	.8	.0	.0	.0	2.5
E	.0	2.0	.0	.0	.0	.0	.0	.0	2.0
SE	.0	1.2	2.6	.4	.0	.0	.0	.0	4.2
S	.0	7.8	15.4	1.9	.0	.0	.0	.0	25.1
SW	.4	.9	3.5	1.8	.0	.0	.0	.0	6.6
W	.7	4.8	3.8	4.7	1.3	.0	.0	.0	15.1
NW	.5	11.1	6.3	4.4	8.8	.0	.0	.0	31.2
IND	.0	2.9	1.3	.0	.0	.0	.0	.0	4.2
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.7	34.9	38.7	13.9	10.9	.0	.0	.0	100.0

NUMBER OF OBS 238 IND=INDETERMINATE

OCT WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.7	3.3	1.2	1.4	.0	.0	.0	7.6
NE	.5	1.5	5.5	4.7	2.2	1.5	.0	.0	15.9
E	.0	3.1	2.3	4.6	1.7	.3	.0	.0	12.1
SE	.0	2.0	1.0	1.5	.6	.0	.0	.0	5.1
S	.5	2.0	4.0	3.2	.8	.0	.0	.0	10.5
SW	.0	3.3	8.1	2.5	.0	.0	.0	.0	13.9
W	.5	.3	8.1	2.8	2.1	3.2	.0	.0	15.0
NW	.5	4.8	2.8	4.4	3.7	1.4	.0	.0	17.5
IND	.0	.0	.5	.0	.0	.0	.0	.0	.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.8	20.7	33.6	24.9	12.4	6.5	.0	.0	100.0

NUMBER OF OBS 217 IND=INDETERMINATE

SEPT WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	1.7	10.5	3.8	.8	.4	.0	.0	.0	17.2
6-7	.0	18.9	30.7	10.5	7.1	.0	.0	.0	67.2
8-9	.0	2.9	2.9	2.5	3.4	.0	.0	.0	11.8
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	2.5	1.3	.0	.0	.0	.0	.0	3.8
TOTAL	1.7	34.9	38.7	13.9	10.9	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE (DIR IN DEGREES)
238	5.0	8	320	SEA	26 12	

OCT WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	1.4	16.6	14.7	5.1	.0	.0	.0	.0	37.8
6-7	.5	2.3	15.2	13.2	2.8	.5	.0	.0	34.4
8-9	.0	1.8	3.2	4.6	8.3	2.3	.0	.0	20.2
10-11	.0	.0	.0	.0	1.4	3.7	.0	.0	5.1
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	.5	.0	.0	.0	.0	.0	.5
TOTAL	1.8	20.7	33.6	24.9	12.4	6.5	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE (DIR IN DEGREES)
217	7.5	8	250	SEA	04 15	

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 10
CLIMATOLOGICAL DATA

Ocean Weather Station 'CHARLIE' 52°45'N 35°30'W September and October, 1973

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
SEPT	7.2	25 00	11.1	14.1	01 18	1.2	24 21	8.3	13.4	30 18	10.0	*28 18	11.7	13.2	*05 09	- 4.7	25 00	- .5	3.4	30 12
OCT	4.1	30 18	9.5	14.0	01 00	- 1.4	28 18	6.5	13.2	01 12	8.7	*22 09	10.1	13.9	*17 08	- 3.2	28 12	- .8	3.4	01 00

MONTH	MEANS AND EXTREMES PRESSURE (MB)					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD				LOW CLOUD				DAYS WITH SPECIFIED WEATHER RAIN OR DRZL		SNOW	TSTM	VISBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN									
SEPT	992.0	04 06	1011.6	1024.4	21 12	3.8	18.8	29.9	51.5	9.2	29.5	29.3	36.0	22	22	8	8	7	7	0	0	28	19.2	239
OCT	988.0	*23 12	1011.4	1026.1	16 03	9.3	29.3	23.2	38.2	20.5	38.5	24.2	16.8	24	24	1	0	7	11	2	1	30	18.7	246

** VV=00-03 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

SEPT WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	4.2	4.6	5.0	.0	.0	13.8	17.1
NE	.4	3.8	1.7	.5	.0	.0	6.4	10.3
E	.0	.0	.0	.0	.0	.0	.0	.0
SE	.0	4.3	6.2	.9	.0	.0	11.0	12.5
S	.0	0.4	6.9	3.3	1.7	.0	17.7	19.9
SW	.4	2.8	4.5	3.5	.1	.0	11.3	16.5
W	.0	2.4	7.3	9.6	2.2	.0	21.5	21.9
NW	.4	9.4	5.0	0.4	1.0	.0	18.3	16.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.3	26.3	35.6	28.9	5.0	.0	100.0	17.1

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
239	290	45	27 0900	7.4	272	

OCT WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.8	1.9	1.3	.0	.0	.0	3.3	11.6
NE	.8	1.5	2.7	2.4	.1	.0	7.6	13.9
E	.0	3.2	4.2	2.6	2.7	.0	12.7	20.3
SE	.4	.7	5.6	4.0	.4	.0	11.1	18.7
S	.4	1.7	4.3	9.1	1.6	.4	13.5	23.6
SW	.0	1.8	8.1	6.3	4.3	.8	21.9	24.4
W	.0	.8	9.6	6.6	3.3	.0	20.4	22.8
NW	.4	.9	3.3	2.0	.0	.0	6.6	18.3
CALM	3.3	.0	.0	.0	.0	.0	3.3	.0
TOTAL	9.3	12.0	39.0	29.3	12.6	1.2	100.0	20.8

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
246	210	65	23 1100	7.3	214	

Wave

SEPT WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	4.9	4.1	1.9	.0	.0	.0	.0	10.9
NE	.0	5.1	.4	.5	.0	.0	.0	.0	6.1
E	.0	.7	.0	.0	.0	.0	.0	.0	.7
SE	.0	8.7	1.8	.0	.0	.0	.0	.0	10.5
S	.0	7.9	2.4	.4	1.7	.0	.0	.0	12.4
SW	.0	3.8	3.6	2.2	.1	.0	.0	.0	9.4
W	.0	4.6	7.5	9.8	4.2	.0	.0	.0	29.1
NW	.4	6.5	3.2	6.7	2.9	.0	.0	.0	19.7
IND	.0	.0	2.1	3.8	.0	.0	.0	.0	5.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.4	41.4	25.1	24.3	8.8	.0	.0	.0	100.0

NUMBER OF OBS 239 IND-INDETERMINATE

OCT WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.8	.0	1.3	.0	.0	.0	.0	.0	1.3
NE	.0	.0	3.7	8.7	.1	.0	.0	.0	12.9
E	.0	1.2	5.0	3.5	3.9	.0	.0	.0	13.5
SE	.0	.1	1.3	.4	.2	.0	.0	.0	2.0
S	.0	2.1	0.0	4.0	6.4	.8	.4	.0	13.7
SW	.0	1.8	5.5	3.7	5.6	2.5	.8	.4	20.3
W	.0	1.0	6.9	5.3	3.8	1.3	.8	.0	19.9
NW	.4	1.2	3.3	2.9	1.2	.8	.0	.0	9.9
IND	.0	.8	2.4	1.6	.0	.0	.0	.0	4.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.4	8.9	33.3	30.1	19.1	5.7	2.0	.4	100.0

NUMBER OF OBS 246 IND-INDETERMINATE

SEPT WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.4	35.6	13.0	8.8	1.3	.0	.0	.0	59.0
6-7	.0	5.9	10.0	3.8	4.2	.0	.0	.0	23.8
8-9	.0	.0	.0	7.9	1.3	.0	.0	.0	9.2
10-11	.0	.0	.0	.0	2.1	.0	.0	.0	2.1
12-13	.0	.0	.0	.0	.0	.6	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	2.1	3.8	.0	.0	.0	.0	5.9
TOTAL	.4	41.4	25.1	24.3	8.8	.6	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HGT	PER	DIR	TYPE	DA HR	IND-INDETERMINATE (DIR IN DEGREES)
239	9.5	10	300	SEA	27 12	

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

OCT WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.4	4.5	3.7	1.2	.8	.0	.0	.0	10.6
6-7	.0	2.4	22.8	12.2	8.9	4.5	1.6	.0	52.4
8-9	.0	1.2	4.1	3.7	9.3	1.2	.4	.4	20.3
10-11	.0	.0	.4	10.6	.0	.0	.0	.0	11.0
12-13	.0	.0	.0	.8	.0	.0	.0	.0	.8
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.8	2.4	1.9	.0	.0	.0	.0	4.9
TOTAL	.4	8.9	33.3	30.1	19.1	5.7	2.0	.4	100.0

NUMBER OF OBS	MAX WAVE HGT	PER	DIR	TYPE	DA HR	IND-INDETERMINATE (DIR IN DEGREES)
249	11.5	8	220	SEA	23 13	

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 11
CLIMATOLOGICAL DATA

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — September and October, 1973

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
SEPT	19.0	30 06	23.7	28.6	*04 18	11.1	13 09	18.2	25.7	01 00	23.3	*25 00	25.8	28.4	03 00	- 6.8	26 15	- 2.2	1.2	04 18
OCT	13.8	30 18	19.9	26.2	05 18	4.1	17 06	13.3	22.5	03 03	19.0	31 15	24.2	27.5	*08 00	-10.3	*13 00	- 4.4	2.2	07 18

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR PCPN	DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
SEPT	999.7	15 09	1018.1	1031.4	27 03	35.6	30.5	29.3	10.6	64.8	28.4	5.9	1.7	8	8	0	1	0	2	0	0	27	8.4	236
OCT	998.5	*31 06	1017.8	1028.7	01 15	33.2	26.5	20.4	19.9	50.0	29.2	14.2	6.6	12	12	0	2	0	7	3	0	26	10.6	226

** VV-90-93 AND/OR *=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

SEPT — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.6	5.0	8.9	1.1	.0	.0	15.6	11.9
NE	.0	5.7	12.6	3.4	.0	.0	21.7	14.3
E	.0	1.5	3.7	.6	.0	.0	5.8	13.6
SE	.0	1.9	1.9	1.8	.0	.0	5.6	17.1
S	.0	1.8	2.3	1.5	.0	.0	5.4	17.6
SW	.0	3.6	4.9	.6	.0	.0	9.1	12.4
W	.0	8.6	6.3	1.1	.0	.0	16.4	11.3
NW	.2	6.9	10.1	1.0	.0	.0	18.1	11.8
CALM	4.2	.0	.0	.0	.0	.0	4.2	.0
TOTAL	5.1	34.7	40.2	11.0	.0	.0	100.0	12.8

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
236	170	40	15 0700	3.1	349	

OCT — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	4.8	3.9	2.4	1.7	.0	12.7	17.8
NE	.0	8.2	9.2	3.5	1.7	.8	23.3	17.4
E	.0	.8	5.6	1.0	1.1	1.0	9.5	23.2
SE	.0	1.0	3.7	1.4	.0	.0	6.1	18.2
S	.0	.8	2.0	1.7	.9	.0	5.3	23.6
SW	.0	1.7	2.9	3.1	.0	.0	7.6	18.3
W	.3	3.9	7.7	2.9	.4	.0	15.3	15.6
NW	.1	4.2	8.8	3.9	.4	.0	17.5	16.1
CALM	2.7	.0	.0	.0	.0	.0	2.7	.0
TOTAL	3.1	25.2	43.8	19.9	6.2	1.8	100.0	17.0

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
226	170	55	*30 0250	4.9	005	

Wave

SEPT — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	1.2	10.1	.6	1.1	.6	.0	.0	.0	13.9
NE	1.0	7.2	6.1	3.4	.0	.0	.0	.0	17.7
E	.7	3.2	4.7	1.1	.0	.0	.0	.0	9.6
SE	1.4	4.0	3.5	.4	.0	.0	.0	.0	9.3
S	.0	3.4	.7	.7	.0	.0	.0	.0	4.9
SW	1.9	8.6	1.4	1.0	.0	.0	.0	.0	12.8
W	3.9	5.0	1.5	.0	.0	.0	.0	.0	10.4
NW	1.4	13.7	1.0	.0	.0	.0	.0	.0	16.3
IND	3.0	1.7	1.3	.0	.0	.0	.0	.0	5.9
CALM	.4	.0	.0	.0	.0	.0	.0	.0	.4
TOTAL	14.8	56.8	20.8	7.5	.0	.0	.0	.0	100.0

NUMBER OF OBS 236 IND=INDETERMINATE

OCT — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.4	5.5	1.4	.4	1.2	1.2	.0	.0	10.3
NE	.9	12.5	4.0	3.7	.9	1.7	.4	.0	24.7
E	.4	9.1	4.2	.8	1.3	.7	.4	.0	15.9
SE	.4	5.0	3.3	.6	.0	.0	.0	.0	9.5
S	.0	.4	2.2	2.3	1.3	.4	.0	.0	6.7
SW	.0	1.1	1.4	1.1	.0	.0	.0	.0	3.7
W	.4	2.9	3.5	1.9	.0	.0	.0	.0	8.7
NW	.9	8.5	4.2	3.0	.1	.0	.0	.0	16.7
IND	.0	5.8	.0	.0	.0	.0	.0	.0	5.8
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	3.5	47.8	25.2	13.7	4.9	4.0	.9	.0	100.0

NUMBER OF OBS 226 IND=INDETERMINATE

SEPT — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	11.9	38.9	6.4	.4	.0	.0	.0	.0	55.5
6-7	.0	10.2	4.2	6.4	.0	.0	.0	.0	20.8
8-9	.0	5.1	1.7	.4	.0	.0	.0	.0	7.2
10-11	.0	2.5	0.8	.4	.0	.0	.0	.0	9.7
12-13	.0	.4	.4	.0	.0	.0	.0	.0	.8
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	3.0	1.7	1.3	.0	.0	.0	.0	.0	5.9
TOTAL	14.8	56.8	20.8	7.5	.0	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE
236	3.5	8	200	SEA	15 09	(DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

OCT — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	3.1	31.9	4.4	.0	.0	.0	.0	.0	39.4
6-7	.4	5.8	14.0	9.3	3.1	2.2	.0	.0	35.4
8-9	.0	3.5	1.8	2.2	1.8	1.3	.9	.0	11.5
10-11	.0	.9	4.4	2.2	.0	.0	.0	.0	7.5
12-13	.0	.0	.0	.0	.0	.4	.0	.0	.4
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	5.8	.0	.0	.0	.0	.0	.0	5.8
TOTAL	3.5	47.8	25.2	13.7	4.9	4.0	.9	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE
226	5.5	8	080	SEA	29 21	(DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 12
Selected Gale Observations, North Atlantic
September and October 1973

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt	Visibility	Present Weather code	Pressure mb	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec	Sea Waves* Height ft	Swell Waves Dir. 10°	Swell Waves Period sec	Swell Waves Height ft
NORTH ATLANTIC		SEP.															
MV CORSICANA	LIBERIAN	3	24.0 N	88.0 W	06	14 M	55 (D)	2 NM	64	1007.7	26.3	27.2					
SS DOCTOR LYKES	AMERICAN	12	43.1 N	27.1 W	18	33	45	10 NM	21	1011.2	18.8	18.8	5	8	30	10	11.5
MV ELISABETH SCHULTE	GERMAN	16	53.4 N	28.4 W	12	30	48	.25 NM	42	999.4	10.5	11.0	9	14.5			
MV HAUL SKAGERAK	NORWEGIAN	22	39.0 N	46.0 W	12	22 M	45 (E)	2 NM	60	1012.0	23.5	22.0	12	20			
MV CARCHESTER	LIBERIAN	23	46.4 N	42.4 W	00	31	50 (E)	5 NM	01	1016.0	10.0	14.0	9	41			
SS TILLIE LYKES	AMERICAN	27	34.0 N	50.0 W	06	22	50	5 NM	82	1004.1	23.6	25.0	5	10			
SS AMER ARCHER	AMERICAN	28	55.4 N	08.5 W	18	32	50	10 NM	01	996.0	10.0	13.4	5	16.5			
SS AMER ARCHER	AMERICAN	29	54.0 N	13.3 W	06	36	60	5 NM	07	1012.5	11.2	13.9	5	14.5	32	>13	19.3
SS AMER ARCHER	AMERICAN	30	51.7 N	31.0 W	18	18	45	5 NM		1023.2	13.9	10.6	4	8			
USCGC SHERMAN	AMERICAN	30	46.0 N	34.0 W	21	26 M	44	5 NM	80	996.2	11.4	11.7	8	19.5			
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC MENDOTA	AMERICAN	5	56.4 N	51.2 W	03	03 M	42	2 NM	80	1002.0	9.0	10.0	5	13			
USCGC SHERMAN	AMERICAN	24	56.5 N	51.0 W	18	29 M	41	5 NM	18	1002.8	4.8	8.0	7	14.5			
USCGC SHERMAN	AMERICAN	26	56.5 N	51.0 W	15	32 M	42	10 NM	02	1013.8	6.2	7.7	8	16.5			
ATLANTIC C																	
USCGC SPENCER	AMERICAN	27	52.5 N	33.2 W	09	29	45	10 NM	02	1011.2	8.7	10.8	10	16.5			
NORTH ATLANTIC		OCT.															
SS AMER ARCHER	AMERICAN	1	49.7 N	35.8 W	06	13	45	1 NM	52	1013.0	13.6	13.9	4	8	20	6	18
USCGC SHERMAN	AMERICAN	1	45.8 N	34.5 W	00	26 M	46	5 NM	02	999.4	11.0	11.7	8	19.5			
SS ZIM MONTREAL	LIBERIAN	7	43.5 N	58.9 W	06	27	41	10 NM	81	1004.0	16.0	16.0	6	6.5			
SS ALMERICA LYKES NEW	AMERICAN	8	38.9 N	50.2 W	12	27	45	10 NM	02	1008.1	21.2	21.2	6	12			
MV HERMANN SCHULTE	GERMAN	11	39.4 N	33.5 W	12	18	60 (F)	.5 NM	64	992.5	21.4	22.0	8	19.5			
SS LASH TURKIYE	AMERICAN	11	40.1 N	30.0 W	18	18 M	45 (F)	2 NM	60	993.6	20.0	20.6	10	19.5			
SS AMER ARCHER	AMERICAN	11	43.4 N	46.2 W	18	26	45 (F)	10 NM	03	1008.5	11.7	18.6	3	10	26	< 6	16.5
SS ORE MERIDIAN	LIBERIAN	12	45.0 N	15.5 W	12	21	45 (F)	5 NM	80	998.6	19.0	19.4	6	11.5			
SS AMER ARCHER	AMERICAN	12	45.9 N	38.4 W	12	26	45	10 NM	80	1006.0	12.2	18.4	5	18			
SS AMER LYNX	AMERICAN	22	29.5 N	74.7 W	06	07	50 (G)	10 NM	02	1012.5	24.4	24.4	12	13			
SS AMER ACE	AMERICAN	23	49.6 N	45.0 W	00	32	45	5 NM	61	997.8	8.8						
SS AMER ARCHER	AMERICAN	23	50.2 N	32.3 W	12	22	50	10 NM	02	1004.0	12.2	14.0	4	16.5			
SS ESSO HOUSTON	AMERICAN	24	27.8 N	69.4 W	18	19 M	45 (G)	10 NM	02	1001.7	26.7	25.6	14	16.5			
SS AMER ARCHER	AMERICAN	24	49.2 N	41.2 W	12	24	45	10 NM	02	1017.0	12.3	13.4	14	24.5			
SS EXPORT BANNER	AMERICAN	25	34.3 N	74.8 W	12	02	45 (G)	5 NM	64	1005.5	23.2	26.2	6	10	09	12	13
SS ALMERICA LYKES NEW	AMERICAN	25	38.2 N	68.0 W	12	08	50(G)	5 NM	82	1009.8	20.0	23.0	8	19.5	08	8	24.5
SS WILLIAM T STEELE	AMERICAN	25	34.5 N	75.9 W	21	36	50(G)	5 NM	02	1008.8	22.0	26.1	8	19.5	08	>13	29.5
SS RIO ORINOCO	LIBERIAN	25	36.0 N	74.0 W	18	03	45(G)	5 NM		1003.0	23.0	25.0	14	21			
SS ORE MERCURY	LIBERIAN	25	32.4 N	72.3 W	12	33	45(G)	5 NM	80	998.0	22.8	25.0	8	10			
SS ERIC K HOLZER	AMERICAN	25	33.5 N	73.7 W	18	35	45(G)	2 NM	02	999.6	21.0	23.3	10	18			
SS CHEVRON LIEGE	PANAMANIAN	26	37.5 N	71.6 W	00	07	55(G)	5 NM	02	1006.3	22.8	25.0	8	16.5			
USCGC TANEY	AMERICAN	26	37.9 N	70.6 W	03	08 M	50(G)	5 NM	80	1002.5	22.8	26.7	8	28			
SS RIO ORINOCO	LIBERIAN	26	35.2 N	74.6 W	00	01	45(G)	5 NM		1003.1	23.0	26.1	14	21			
SS WILLIAM T STEELE	AMERICAN	26	34.8 N	73.4 W	03	36	55(G)	5 NM	02	1006.8	20.0	27.3	8	19.5	08	>13	29.5
SS PRES GRANT (NEW)	AMERICAN	26	38.4 N	73.1 W	00	01	50(G)	2 NM	07	1007.5	17.7	17.7	10	19.5			
SS PANAMA	AMERICAN	26	38.5 N	72.9 W	18	36	45(G)	2 NM	05	1004.4	18.6	21.1	7	16.5			
SS EXPORT BANNER	AMERICAN	26	37.2 N	74.6 W	00	36	45(G)	5 NM	02	1008.0	19.2	20.0	8	6.5	07	>13	16.3
SS ADM W M CALLAGHAN	AMERICAN	27	36.6 N	64.0 W	15	28	48(G)	10 NM	02	1003.0	22.4	22.4	9	11.5			
SS CHEVRON LIEGE	PANAMANIAN	27	38.8 N	70.5 W	00	01	41(G)	5 NM	02	1004.6	18.1	22.8	9	16.5			
SS AMER LEGEND	AMERICAN	28	47.6 N	34.7 W	18	18	42(G+)	10 NM	01	1017.8	13.0	13.3	8	13			
MV STOLT LLANDAFF	BRITISH	28	44.2 N	43.6 W	06	18	47(G+)	5 NM	07	1008.7	17.0	19.2	XX	19.5			
MV PHOSPHORE CONVEYOR	LIBERIAN	28	46.0 N	55.9 W	06	31	43(G+)	200 YD	65	990.0	8.5		9	19.5			
SS AMER LEGEND	AMERICAN	29	46.8 N	35.9 W	00	18	48(G+)	2 NM	92	1013.9	14.4	13.4	8	24.5			
MV CAMPECHE	MEXICAN	29	30.2 N	79.6 W	12	32 M	42	5 NM	01	1011.2	17.2	29.0					
SS LIGHTNING	AMERICAN	29	48.6 N	41.5 W	18	29	50(G+)	10 NM	01	1018.0	6.7	13.9	8	18			
SS EXPORT LEADER	AMERICAN	29	40.5 N	64.5 W	12	20	50	10 NM	02	1000.7	20.0	20.0	10	19.5			
SS EXPORT LEADER	AMERICAN	30	40.9 N	54.7 W	12	20	55	10 NM	02	1005.6	20.0	18.3	10	19.5			
SS AMER LEGEND	AMERICAN	31	42.1 N	57.2 W	12	14	44	5 NM	03	1012.0	19.4	14.4	10	14.5			
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC BIRB	AMERICAN	4	56.5 N	50.9 W	03	29 M	48	5 NM	01	1006.0	4.2	3.3	8	16.5			
USCGC MORGENTHAU	AMERICAN	25	56.5 N	51.0 W	12	32 M	41	5 NM	26	1012.9	2.6	5.0	7	11.5			
USCGC MORGENTHAU	AMERICAN	28	56.8 N	51.2 W	21	34 M	45(G+)	10 NM	02	989.6	3.1	5.6	7	13			
USCGC MORGENTHAU	AMERICAN	29	54.8 N	51.7 W	12	29 M	32(G+)	10 NM	15	1006.3	0.0	5.6	10	21			
ATLANTIC C																	
USCGC CAMPBELL	AMERICAN	23	52.6 N	35.1 W	15	22 M	64	1 NM	07	991.8	9.3	9.9	8	37.5			
USCGC CAMPBELL	AMERICAN	28	52.6 N	35.5 W	21	17 M	50(G+)	2 NM	07	1001.0	12.2	9.0	7	26			
ATLANTIC H																	
USCGC TANEY	AMERICAN	25	38.0 N	71.0 W	09	07	50 (G)	5 NM	07	1010.3	20.8	25.0	9	16			
USCGC TANEY	AMERICAN	27	38.0 N	71.0 W	00	02	42 (G)	5 NM	07	1002.0	19.4	25.6	7	23			
USCGC TANEY	AMERICAN	30	38.0 N	71.0 W	00	17	43	5 NM	80	1005.6	22.9	21.7	8	16			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(D) Tropical storm Delia
(E) Hurricane Ellen
(F) Hurricane Fran
(G) Tropical storm Gilda
(G+) Extratropical storm Gilda

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Table 13
U.S. Ocean Station Vessel Climatological Data, North Pacific

Ocean Weather Station 'NOVEMBER' 30°00'N 140°00'W September and October, 1973

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
SEPT	20.0	•10 19	22.4	28.3	•11 03	15.7	29 18	18.4	25.0	01 03	22.2	•13 03	23.2	24.4	•20 03	- 3.8	•08 15	- .8	6.1	10 03
OCT	18.4	18 12	21.2	26.1	25 06	11.6	22 06	16.7	19.8	07 15	21.7	•31 21	22.6	24.4	•30 09	- 5.6	•9 15	- 1.4	4.0	29 06

MEANS AND EXTREMES — PRESSURE (MB)

MONTH	MIN	DA HR	MEAN	MAX	DA HR
SEPT	1014.0	10 15	1021.1	1028.1	•25 06
OCT	1005.0	16 00	1021.6	1029.8	26 18

PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS)

MONTH	TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC
SEPT	20.5	22.6	37.2	19.7	25.1	23.4	32.6	18.8
OCT	28.6	28.8	28.8	13.9	36.8	28.8	24.1	12.3

DAYS WITH SPECIFIED WEATHER

MONTH	RAIN OR DRZL	SNOW	TSTM	VSBY <1KM ••	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
SEPT	17	0	0	0	0	0	0	28	6.2	239
OCT	20	0	0	0	1	0	0	18	7.4	163

PCPN 17 17 0 0 0

Table 14

Selected Gale Observations, North Pacific

September and October 1973

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility	Present Weather code	Pressure mb	Temperature °C		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt				Air	Sea	Period sec	Height ft	Dir. 10°	Period sec	Height ft
NORTH PACIFIC		SEP.															
MV VAN FORT	LIBERIAN	7	51.8 N	159.5 W	18	25	N 41	1 NM		984.5	8.0	9.0	10	36			
SS CHEVRON CALIFORNIA	AMERICAN	8	52.8 N	152.4 W	00	22	50	2 NM	81	990.2	10.0	9.4	8	19.5			
MV ROBERTS BANK	LIBERIAN	9	48.8 N	169.4 E	06	13	45	1 NM	61	1002.7	10.8	8.5	4	10			
MV HARBOUR BRIDGE	SINGAPORE	10	49.2 N	169.8 W	12	17	N 41	5 NM	02	998.1	9.0	10.0	6	11.5			
MV VAN FORT	LIBERIAN	10	49.1 N	177.3 W	18	29	N 44	1 NM	25	991.0	13.0	9.0	12	32.5			
SS JAPAN BEAR	AMERICAN	11	37.6 N	149.7 W	06	28	N 48	5 NM	21	1009.2	17.2	20.0	8	11.5			
MV ROBERTS BANK	LIBERIAN	11	51.7 N	167.8 W	18	20	41	5 NM	61	982.5	8.5	7.5	5	11.5	22	8	19.5
MV TRUMPH	PANAMANIAN	11	37.0 N	150.4 W	06	29	N 42	1 NM	18	1011.0	18.0	23.0	10	18			
MV ROBERTS BANK	LIBERIAN	12	51.7 N	165.5 W	00	19	48	5 NM	02	990.0	10.0	7.4	8	10	22	8	19.5
MV CHALMETTE	LIBERIAN	14	52.1 N	168.9 W	06	15	N 42	5 NM	02	988.0	9.0	9.0	7	26			
MV CHALMETTE	LIBERIAN	15	51.5 N	164.3 W	00	24	N 50	5 NM	02	985.6	9.5	8.0	8	19.5			
MV EMMA JOHANNA	GERMAN	15	39.9 N	163.9 E	21	27	44	5 NM	01	1009.0	18.5	19.0	8	16.5			
MV EASTERN BUILDER	LIBERIAN	15	44.7 N	159.2 E	12	02	N 50	2 NM	81	997.0	13.0	15.0	9	24.5			
MV VAN FORT	LIBERIAN	15	41.1 N	153.7 E	00	33	N 49	1 NM		989.3	20.0	20.0					
MV EMMA JOHANNA	GERMAN	16	39.9 N	166.6 E	03	28	41	5 NM	02	1010.5	18.6	19.5	8	13			
MV SPERO	NORWEGIAN	16	42.3 N	173.5 E	18	27	52	5 NM	80	1010.0	15.0	13.0	8	23			
MV OSWEGO PATRIOT	LIBERIAN	19	40.9 N	139.5 W	00	28	41	10 NM	01	1008.0	19.0	20.0	7	10			
MV GLOMAR CHALLENGER	AMERICAN	21	36.8 N	176.9 E	03	23	N 44	10 NM	02	1004.0	26.1	24.4	10	11.5			
MV SACRAMENTO VENTURE	LIBERIAN	21	41.5 N	178.2 W	06	24	N 48	1 NM	80	998.6	18.0	23.0	6	14.5			
MV VOLNAY	BRITISH	21	41.6 N	178.5 W	00	09	N 60	1 NM	65	998.0	15.0						
MV SONETTE	SWEDISH	21	44.1 N	169.7 W	12	11	50	2 NM	63	997.3	11.0	13.0	12	19.5			
MV SONETTE	SWEDISH	22	43.8 N	162.0 W	18	25	44	2 NM	15	1006.5	14.0	14.0	12	39			
MV EASTERN BUILDER	LIBERIAN	23	50.3 N	137.8 W	18	13	N 42	.5 NM	21	995.0	12.0	11.0	11	14.5			
MV SONETTE	SWEDISH	23	43.6 N	160.2 W	00	27	55	5 NM	02	1010.0	15.0	14.0	12	39			
SS DAISHOWA MARU	JAPANESE	24	50.3 N	164.8 W	06	17	N 43	1 NM	81	979.0	10.0	8.0	6	13			
MV PHIL PRES QUEZON	PHILIPPINE	28	34.0 N	150.2 W	18	07	N 42	10 NM	02	1023.5	21.5	24.5	8	13			
MV MONTIRON	LIBERIAN	29	53.9 N	171.1 W	18	18	N 43	< 50 YD		1001.0	7.3	7.0	10	19.5	18	10	23
SS GEORGE L PARKHURST	LIBERIAN	29	33.8 N	174.0 W	06	09	41	5 NM	25	1014.2	24.0	25.6	12	26			
MV PEARL VENTURE	LIBERIAN	30	41.5 N	169.1 E	00	02	N 41	5 NM	01	1021.6	14.5	17.0	10	8			
MV ELI MAERSK	DANISH	30	55.6 N	156.5 W	12	08	44	10 NM	02	1033.0	19.6	22.0	10	14.5			
MV MONTIRON	LIBERIAN	30	52.9 N	173.4 W	06	18	N 43	.5 NM	10	1000.6	11.2	8.0	8	14.5			
SS GEORGE L PARKHURST	LIBERIAN	30	34.0 N	172.0 W	00	09	41	5 NM	25	1015.9	25.0	25.6	12	26			
NORTH PACIFIC		OCT.															
SS PHIL MAIL	AMERICAN	1	43.1 N	155.3 E	12	14	45	5 NM	03	1018.0	18.4	25.0	8	14.5			
MV MONTIRON	LIBERIAN	1	52.6 N	177.5 E	12	31	N 43	.5 NM	10	1002.7	12.2	7.0	9	19.5			
SS AMER CORSAIR	AMERICAN	4	40.5 N	167.6 W	12	02	45	5 NM	02	1030.5	11.7	17.2	4	10	02	11	24.5
MV ROBERTS BANK	LIBERIAN	4	41.7 N	158.2 W	18	04	46	5 NM	02	1014.2	13.2	13.5	8	14.5			
SS AMER CORSAIR	AMERICAN	5	39.9 N	163.1 W	00	01	55	5 NM	02	1015.0	12.2	17.8	11	29.5			
SS SEA LIFT	AMERICAN	5	41.8 N	161.7 W	03	04	49	5 NM	07	1015.2	12.2	18.2	9	18			
USNS GREENVILLE VICTORY	AMERICAN	5	42.0 N	163.0 W	06	04	42	10 NM	02	1022.7	12.7	14.4	12	16.5			
MV ROBERTS BANK	LIBERIAN	5	41.4 N	159.8 W	00	03	55	2 NM	50	1012.5	13.2	13.5	8	21			
SS SARAPIN TOPIC	LIBERIAN	7	21.6 N	124.7 E	15	09	N 30 (N)	5 NM	03	1005.0	29.0	30.0					
MV HOEGH ELAN	NORWEGIAN	7	32.8 N	173.3 W	12	16	45	2 NM	64	998.2	20.2	23.0	9	19.5			
MV WORLD PELAGIC	LIBERIAN	8	42.4 N	165.2 E	18	23	42	5 NM	01	998.0	15.0	15.0		13			
SS PHILLIPS LOUISIANA	LIBERIAN	8	36.7 N	155.0 W	12	08	48	> 25 NM	02	1025.0	15.5	20.0	8	16.5			
MV GEORGIANA	LIBERIAN	9	40.0 N	177.4 E	00	18	N 42	10 NM	93	1015.5	19.0	18.0	9	19.5			
MV KINYO MARU	JAPANESE	9	46.1 N	174.2 E	00	13	N 45	1 NM	65	995.5	11.5	10.0	8	11.5			
MV LIECHTENSTEIN	LIBERIAN	9	50.5 N	178.8 W	12	19	N 50	2 NM	81	981.5	9.0	8.3	XX	18			
MV HONSHU MARU	JAPANESE	9	47.0 N	169.4 E	06	28	N 44	5 NM	02	997.0	8.0	11.0	13	16.5			
USCGC JARVIS	AMERICAN	10	33.1 N	170.6 W	12	25	N 60	5 NM	02	991.7	7.2	6.0	14	29.5			
USCGC BOUTWELL	AMERICAN	10	54.3 N	161.0 W	12	23	N 48	2 NM	07	989.5	7.8	8.0	8	19.5			
MV BEISHU MARU	JAPANESE	10	54.3 N	168.2 W	06	21	N 45	2 NM		987.7	6.0	9.0	9	16.5			
MV LIECHTENSTEIN	LIBERIAN	10	50.2 N	179.2 E	00	28	N 45	2 NM	81	998.0	9.0	8.1	12	19.5			
SS WASHINGTON	AMERICAN	10	32.3 N	153.5 E	00	08	N 45	200 YD	64	1014.2	25.0	26.7	6	11.5			
USCGC BOUTWELL	AMERICAN	11	54.4 N	162.5 W	00	27	N 47	5 NM	07	997.0	7.7	7.8	6	13			
SS WASHINGTON MAIL	AMERICAN	11	34.0 N	159.9 W	06	26	45	5 NM	02	1003.1	8.3	8.9	15	19.5			
SS ZOELLA LYKES	AMERICAN	14	33.8 N	148.0 E	12	23	47	5 NM	64	1005.8	21.7	25.0	9	14.5			
MV CHALMETTE	LIBERIAN	16	53.7 N	148.2 W	06	28	42	5 NM	02	1000.0	8.6	7.4	8	14.5			
SS CALIFORNIA	AMERICAN	16	39.9 N	161.6 E	12	01	50	5 NM	21	1021.3	14.4	20.0	5	13			
SS SANTA CLARA	AMERICAN	17	52.3 N	156.1 W	18	27	45	5 NM	03	1002.4	8.3	8.9	14	19.5			
MV MONTIGNY	LIBERIAN	17	53.3 N	158.5 W	18	31	N 46	5 NM	02	1004.7	6.2	12.0	8	19.5			
MV CHALMETTE	LIBERIAN	17	52.8 N	160.1 W	18	30	45	5 NM	03	1006.5	6.2	7.5	9	19.5			
USCGC JARVIS	AMERICAN	18	53.8 N	160.4 W	12	29	N 50	5 NM	07	1009.2	6.1	7.4	12	24.5			
MV MONTIGNY	LIBERIAN	18	52.4 N	151.4 W	12	29	N 44	10 NM	02	999.7	6.0	12.0	8	18			
MV CHALMETTE	LIBERIAN	18	52.8 N	161.8 W	00	30	N 48	5 NM	02	1010.3	8.8	7.0	9	19.5			
SS SANTA CLARA	AMERICAN	18	53.9 N	157.2 W	18	28	45	2 NM	21	1002.0	4.5	7.8	8	24.5			
USCGC JARVIS	AMERICAN	20	55.0 N	155.6 W	12	33	N 45	10 NM	02	1006.0	5.0	6.4	8	16.5			
USCGC JARVIS	AMERICAN	21	56.1 N	154.0 W	06	31	N 45	10 NM	01	1003.8	4.4	7.0	7	16.5			
SS NORTH STAR 3RD	AMERICAN	22	58.5 N	167.9 W	06	18	N 48	1 NM	61	990.2	2.2	6.7	10	19.5			
SS PRES MCKINLEY (NEW)	AMERICAN	22	37.3 N	136.6 W	06	27	45	5 NM	25	1000.7	16.2	17.8	9	13			
SS CHEVRON CALIFORNIA	AMERICAN	23	38.6 N	125.9 W	12	28	43	10 NM	02	1014.3	14.7	14.4	8	14.5			
SS MASJM LYKES NEW	AMERICAN	24	22.2 N	121.4 E	00	02	N 45	5 NM	03	1015.0	25.6	26.7	6	10			
MV CHALMETTE	LIBERIAN	24	42.2 N	155.0 E	00	31	47	10 NM	80	1009.0	10.7	14.4	6	13	27	6	16.5
MV VAN FORT	LIBERIAN	24	48.4 N	164.6 W	18	29	42	5 NM	01	994.0	10.0	8.0	14	32.5			
MV HONSHU MARU	JAPANESE	26	48.9 N	171.0 W	00	33	N 42	2 NM	07	979.0	7.0	6.5	6	11.5	31	13	16.5
MV VAN FORT	LIBERIAN	26	49.2 N	172.6 W	00	32	42	5 NM	01	985.0	6.0	7.0					
MV WAY WAY	LIBERIAN	27	46.4 N	178.1 E	06	06	58	1 NM	07	999.0	8.0						
MV QUEENS WAY BRIDGE	JAPANESE	27	43.5 N	164.9 W	23	18	N 51	2 NM	80	994.5	15.0	11.0	7	11.5			
SS PRES POLK	AMERICAN	28	43.2 N	157.9 W	12	18	48	5 NM	02	999.7	12.8	12.2	6	13			
USCGC JARVIS	AMERICAN	29	51.2 N	157.0 W	06	30	N 58	2 NM	61	992.5	3.9	6.8	14	24.5			
SS GALVESTON	AMERICAN	29	50.7 N	133.5 W	06	16	50	2 NM	02	1016.6	8.8	10.7	9	16.5			
SS ARCO SAG RIVER	AMERICAN	29	49.0 N	136.5 W	06	20	45	10 NM	02	1007.1	11.0	9.4	9	23			
USCGC IRONWOOD	AMERICAN	29	58.9 N	152.6 W	12	02	N 45	1 NM	59	982.4	4.5		7	10			
SS SANTA MARIA	AMERICAN	29	55.2 N	145.3 W	18	23	60	5 NM	02	985.4	5.5	7.8	12	36			
SS SUNMIT	AMERICAN	29	56.2 N	157.0 W	06	35	45	> 25 NM	02	982.4	3.9	7.2					
SS OREGON MAIL	AMERICAN	29	50.0 N	155.3 W	12	27	45	5 NM	25	1007.5	5.5	4.0	7	11.5			
MV HONSHU MARU	JAPANESE	30	46.6 N	157.8 E	06	31	N 42	2 NM	07	999.0	7.5	8.0	7	13	30	11	19.5
SS SANTA MARIA	AMERICAN	30	54.7 N	145.3 W	00	27	90	.25 NM		1000.7	5.5	7.7	14	55.5			

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility	Present Weather code	Pressure mb	Temperature °C		Sea Waves†		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt				Air	Sea	Period sec	Height ft	Dir. 10°	Period sec	Height ft
NORTH PACIFIC OCEAN		OCT.															
SS PHILADELPHIA	AMERICAN	30	34.6 N	137.1 W	06	26	47	10 NM	18	1009.8	7.2	7.8	8	19.5			
MV VAN FORT	LIBERIAN	30	45.7 N	137.5 E	06	31	48	5 NM	00	1002.0	8.0	9.0					
MV WORLD PELAGIC	LIBERIAN	30	42.0 N	179.5 E	12	18	44	2 NM	00	1002.0	14.0	16.0	8	19.5			
SS MARJORIE LYKES	AMERICAN	31	33.6 N	151.7 E	12	27	48	3 NM	02	1011.2	21.2	23.3	3	10			
MV WORLD PELAGIC	LIBERIAN	31	43.4 N	179.0 W	12	16	48	.5 NM	03	1002.0	11.0	12.0		19.5			

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(N) Typhoon Nora

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Rough Log, North Atlantic Weather

December 1973 and January 1974

ROUGH LOG, DECEMBER 1973--The traces of the centers of the extratropical cyclones this month were very close to normal. The number of storms was below normal. As is usual, the origin over North America was diffuse, but two favorite paths stood out. One was over the Great Lakes toward Labrador, then dividing through either the Davis Strait or Denmark Strait. The other was along the United States east coast toward Newfoundland and on toward Iceland. There were several centers that toured the Mediterranean Sea and cyclone centers in the south-central part of the ocean that the climatological track charts do not indicate.

The mean sea-level pressure chart pattern appeared normal only across the 50° to 60°N parallel band, and there the pressure values were above normal. The main low-pressure center (Icelandic Low) was shifted many miles to the east, near 70°N, 10°E, at 993 mb. Climatology locates it near 62°N, 35°W, at 1000.7 mb. Another low center was over the Labrador Sea, near 62°N, 55°W, at 1004 mb. Between the two Lows, a high-pressure ridge bulged southward from northern Greenland over the Denmark Strait. The center of the Azores High was located near its normal position of 35°N, 33°W, at 1025 mb, compared to a 1021.1-mb climatic pressure. The 1020-mb isobar, which usually covers the area of 30° to 40°N and 20° to 50°W, encircled most of the ocean area from Newfoundland to Cape Finisterre to Cabo Bajador to Florida. The pressure over the eastern United States was very flat, averaging about 1019 mb. A 1015-mb Low was centered in the Mediterranean Sea near Sardinia. Very straight zonal flow stretched from Labrador into central U. S. S. R. between 50° and 60°N.

The anomaly chart was very complicated. The major anomaly centers were as follows: a large negative 14 mb over central U. S. S. R., with a secondary negative 12 mb just off the Norwegian coast near Bodø; a negative 2 mb over Baffin Bay, with a positive 10 mb over northeastern Greenland; a positive 11 mb over western Hudson Bay; a positive 9 mb east of Newfoundland, near 48°N, 48°W; and a positive 8 mb center in midocean, near 52°N, 37°W. The isolines surrounding these centers made a complicated pattern.

With the complex pressure and anomaly patterns, it is a wonder that the storm tracks paralleled the climatological pattern as closely as they did. There were no tropical cyclones this month.

This first LOW of the month formed on an Arctic front, after it had moved many miles over the ocean, near 40°N, 50°W, at 1200 on the 2d. It moved southwestward and deepened, dropping to 994 mb by 1200 on the 3d. The IVERNESS, about 300 mi southwest of the center, found 50-kt winds and 16-ft seas. The ETHA and the FARMSUM were buffeted by gales to 45 kt on the west side of the LOW.

At 1200 on the 4th, the 986-mb LOW was at 38°N, 49°W, with gale winds reported in all but the southeast quadrant. The IVERNESS was still being pounded by 50-kt winds. The LOW had slowly circled almost back to its origin (fig. 35). The FARMSUM had slowed

Figure 35.--This almost perfectly defined LOW with its trailing cold front pounded the IVERNESS and FARMSUM with high winds and seas on December 4.

on its northeastward track, while fighting the 45-kt winds and 20-ft seas. The surface LOW was stacked almost vertically with an upper-air LOW, but, on the 6th, the upper-air LOW was breaking away from the main circulation to become a cutoff LOW. As this happened, the storm lost its dynamic support and began to fill, while drifting southward.

The surface LOW continued its southward movement to about 22°N, 42°W, at 0000 on the 10th, when it turned northeastward and dissipated on the 12th. It took one last swipe at shipping on the 11th, when the BREITENSTEIN was hit by 50-kt winds driving 13-ft seas and 16-ft swells to the northwest of the center.

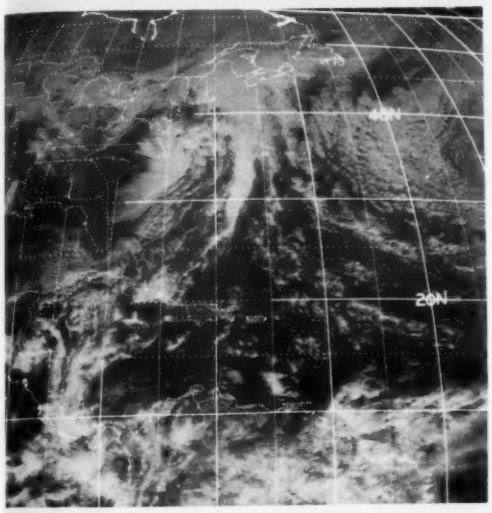

Figure 36.--This satellite picture shows the storm already well developed off Cape Hatteras earlier in the day.

This storm originated as a 1014-mb LOW on a front off South Carolina. It moved north-northeastward up the coast along the Gulf Stream, but didn't really start developing until the 11th (fig.36) off Cape Hatteras. At that time, a U.S.S.R. research vessel was at 37.8°N, 67.1°W, and was rolled by 40-kt winds and 26-ft seas from the south on her portside.

For the next 60 some hr, the LOW continued up the coast, passing over the Gulf of St. Lawrence on the 12th. Reports of isolated gale-force winds accompanied it on the journey. By 0000 on the 14th, the 989-mb center was over the Labrador Sea, and, at 0600, split into two centers on the tip of Greenland. The main LOW moved into Baffin Bay, treating shore installations to 40- and 45-kt winds. On the 15th, it died near Thule.

The eastern center continued deepening and moved across Iceland. The center passed almost directly over Ocean Station Vessel "A" and, at 0000 on the 15th, hammered her with 60-kt winds and 30-ft seas. Keflavik had 45-kt southerly winds, which 12 hr later had shifted to 40-kt northerly winds. Ocean Station Vessel "I" had 40-kt gales, over 300 mi to the south, and was pounded by 20-ft seas. As the LOW continued eastward, 40- and 45-kt winds were felt on all sides, including Ocean Station Vessel "M." The coastal areas of Ireland, England, and the North Sea countries took a beating, as westerly and northwesterly winds pounded water on their shores. The storm moved inland near Oslo on the 17th and continued into Finland.

Monster of the Month--Several LOWs developed in an area of weak gradient northeast of Bermuda on the 13th. These consolidated into one 1004-mb LOW on the 14th. The LAPLAND was near the center and reported a 65-kt wind. This report could have been an error in transmission or connected with a thunderstorm, as the weather was missing, but other ships reported cumulonimbus clouds in the area. The LOW rapidly developed a good circulation, and the MORMACTRADE was lashed by 45-kt winds. The LOW moved northward and weakened, and was almost absorbed by another LOW over Nova Scotia at the time. The warmer waters of the Gulf Stream regenerated the storm and it took an easterly track, still not being of much concern to ships.

At 0000 on the 18th, it was a different matter, though, as Ocean Station Vessel "C" found itself engulfed in 50-kt winds and 15-ft seas. At 1200 on the 18th, the central pressure had dropped to 973 mb, near 51°N, 21°W. The OLENEGORSK was at 49°N, 29°W, when she was ravaged by 65-kt winds and 36-ft seas. Twenty-four hours earlier, she had been placidly cruising with smooth seas and a 15-kt breeze. The NOVGOROD, about 180 mi to the southeast, was whipped by 45-kt winds, 26-ft seas, and 20-ft swells. As the LOW passed to the south, Ocean Station Vessel "J" battled 50-kt winds and 31-ft seas.

The storm was not weakening yet, and was moving eastward very slowly. Ocean Station Vessel "J" now had 60-kt winds and "K" to the south, 50 kt (fig. 37). "Kilo" was struggling to stay afloat in 41-ft seas, while "J" had problems with 30-ft seas and 23-ft swells. The LOVERVAL, at 50°N, 17°W, was mauled by 55-kt storm winds and 43-ft seas. On the 20th, the LOW moved into the Bay of Biscay, and Ocean Station

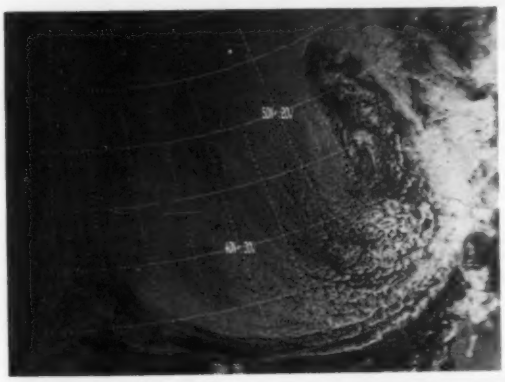

Figure 37.--The LOW center appears to be near 45°N, 13°W, in this satellite picture on the 19th. The cloud cover vividly depicts the north-south elongated shape of its circulation.

Vessel "K" was still battling 55-kt winds, 39-ft seas, and 26-ft swells; and "J," 45-kt gales with 36-ft seas and 39-ft swells. At 1200 on the 20th, there were 14 reports of winds between 40 and 55 kt. This did not include three reports that were considered suspect, one of 75 kt and another of 65 kt. The meteorologist that plotted or analyzed the chart did not indicate why the reports were suspect, possibly because of location.

Late on the 20th, the storm took a sudden turn to the north; on the 21st, to the west; and again to the south on the 22d and 23d, into the Bay of Biscay. The LOW was rapidly weakening, but again ravaged shipping on the 22d and 23d, with gale-force winds up to 45 kt. Another LOW developed near Lisboa late on the 23d and became the main circulation on the 24th.

An east-west-oriented front had stagnated just south of the United States Gulf coast for several days. Minor waves had moved eastward along the front. On the 16th, the push from a cold High in Canada was enough to move the western part of the front southward, and a more stable wave formed off Florida.

In 12 hr it had moved eastward, off Georgia and over the Gulf Stream, with an elongated circulation stretching all along the East Coast. The CAPE BRETON MINER off Cape Cod was blown by 45-kt gales. Ocean Station Vessel "H" was riding 40-kt winds. By 1200 on the 17th, the 988-mb LOW was off Norfolk, and "H" measured 60-kt storm winds. At 0000 on the 18th, "H" was still being churned by 50-kt winds and 26-ft seas. The TEXACO RHODE ISLAND, about 100 mi to the south, had the same wind and even higher seas--41 ft.

The storm continued on a northerly track, moving over land near Rhode Island late on the 17th, but it did not weaken, although 35- to 40-kt winds were the highest reported from ships off the coast.

This was one of the worst December storms to strike the United States east coast in years. Up to 11 in of gale-driven snow snarled some areas, sleet and freezing rain sheathed other areas. The ice storm caused the worst misery because of power outages due to fallen lines. At least seven deaths were storm-related. Three people were electrocuted by fallen powerlines. Thousands of homes in New England were without light, heat, and water. Utility companies called the storm the worst in 20 yr.

By the 20th, the 974-mb center had traveled to Cape Chidley. The CAPE BRETON MINER had followed the storm north and experienced 50-kt winds in the Gulf of St. Lawrence. Two ships off the Labrador coast were frozen by 40-kt winds, with temperatures in the teens and low twenties.

At 1200 on the 20th, the CAPE BRETON MINER was still battling 55-kt freezing winds, and Ocean Station Vessel "B" measured 35-kt gales and 15-ft seas. The LOW moved eastward again to the rugged Greenland coast, where it deposited heavy snow, but the high pressure over the Greenland icecap and the rugged coast dissipated the circulation.

This LOW can be traced from Saskatchewan, Canada, on the 21st, where it developed in a 999-mb trough. It took 2 1/2 days to travel along the border and over the Great Lakes to reach the coast late on the 23d. During this time, the pressure had risen to 1009 mb, but it had maintained a small circulation.

Prior to reaching the Maine coast, another LOW had moved up the United States east coast during the period of the 20th to the 22d, causing gale winds and an isolated report of 50- and 55-kt winds.

On Christmas day, the LOW was centered off St. John's, Newfoundland, and the pressure had dropped to 988 mb. At 0000, SEDCO I was hammered by 50-kt winds, with 15-ft seas riding 16-ft swells. Twelve hours later, the AMERICAN LEADER reported 55-kt winds near 44.5°N, 42.5°W. The AMERICAN LEGEND, which was headed home for the holidays, was being washed by heavy rain and 40-kt gales at 41°N, 56°W. The drilling rig VGBZ, which has now moved to 45.2°N, 54.7°W, was whipped by 45-kt gales and 18-ft seas.

On the 26th, the LOW moved into the Denmark Strait. At 0000, Ocean Station Vessel "C" rode out 40-kt winds, which decreased to 35 kt 12 hr later. By 1200, the LOW was a 974-mb depression. The TOPDALSFJORD, near 56.5°N, 35°W, reported a roaring hurricane-force wind of 75 kt. By 1200 on the 27th, the 964-mb LOW was in the Norwegian Sea. Another LOW had meantime moved over Newfoundland, and the combined circulation resulted in an almost straight fetch from Newfoundland to Ireland. On the 28th, the LOW moved into the Barents Sea and was incorporated into another system.

A 1004-mb weak area was analyzed near Omaha, Nebr., on the 28th. It moved northeastward across the Great Lakes on the 29th, where it picked up energy and started to deepen and increase its circulation. By the 31st, it was approaching Goose Bay, Labrador, at 982-mb pressure. The CAPE BRETON MINER again was swept by 45-kt gales. The last report that I could find on the charts identified as Ocean Station Vessel "C" was for 0000 on the 31st. On the 1200 chart, a 45-kt report identified only as a ship was probably "Charlie" headed home. On the 0000 January 1 chart, the USCGC MORGENTHAU, near 49.5°N, 44.5°W, reported a roaring 60-kt, as the LOW was near 56°N, 43°W, with a pressure of 984 mb. Ocean Station "B" was fighting 40-kt easterlies. Both had 20-ft seas. Many mariners and airmen will mourn "Charlie's" departure at the end of the year.

With the New Year, a new center took over the major circulation. The LOW had formed near the frontal occlusion and moved around the older center. This mattered little as far as the mariner was concerned. It was still a vicious 972-mb storm. The KRAS, near 49°N, 40°W, and the WILKAWA, near 45°N, 39°W, were headed into 50-kt westerlies, with 20- to 25-ft seas. Far to the south on the 2d, the DART AMERICA was being hit by 50-kt winds, 20-ft seas, and 28-ft swells. There were no other reports between it and the center, 700 mi to the north. As the LOW moved eastward and then northward toward Iceland, another more powerful LOW took over, dominating the circulation from coast to coast.

Gale warnings were posted on the Great Lakes at least three times this month. On the 5th and 6th, a 992-mb LOW out of Oklahoma tracked across Lakes Michigan and Huron. On the 6th, gale warnings for winds up to 45 kt were posted.

On the 13th and 14th, the 989-mb LOW tracked eastward over Ohio, south of the Lakes. Heavy snow occurred in most areas, and gale warnings were up

again. Gusts topped 45 kt on Manitoulin Island, on the Canadian side of Lake Huron.

Figure 38.--The crew members of the AEGIS DUTY await rescue after they were located by a Coast Guard HU-16 amphibious aircraft. World Wide Photo.

Figure 39.--Tugs stand by after initial attempts to free the grounded FREDERICO C. failed. The passengers remained aboard and enjoyed the parties. Wide World Photo.

Casualties--Early in the month, the 11,317-ton NORWEGIAN NORTRANS GLORIA went aground in heavy weather off the entrance of the Bosphorus. The Panamanian SOVEREIGN SAPPHIRE sustained weather damage on a Naples to Savannah voyage. The Cypriot motorvessel AEGIS DUTY sank 145 mi southeast of New York on the 4th. All the crew members were rescued in 5-ft seas (fig. 38). The 20,416-ton Italian cruise ship FEDERICO C ran aground off Port Everglades, Fla., in fog on the 8th (fig. 39). No damage or injuries were reported, except for possible headaches from the free parties while she was aground.

The Cypriot motorvessel IRENES FAITH ran aground in high wind at Windsor, Ontario, on the 6th, with no damage. The DIM BOVITA, a 5,369-ton Romanian motorship, sank in the English Channel off Brest when she ran into heavy seas. High winds drove the 6,395-ton Greek motorship ELIZABETH onto a sandbank off Haifa on the 18th, after she had discharged a cargo of grain. Late in the month, the Liberian motorship MEXICAN TRADER (5,998 tons) had storm damage to her steering gear and ventilation hatches in a storm near 49.5°N, 17.1°W.

The newly built 59,200-ton Liberian-registered bulk carrier ELWOOD MEAD went aground on a reef near Guernsey in the English Channel on the 25th. Stormy weather was hindering salvage operations. The OMONIA (16,741 tons) sustained superstructure damage due to heavy weather on a passage Bajo Grandes to Donges.

ROUGH LOG, JANUARY 1974--The cyclones of the North Atlantic this month were normal in number and in the paths their centers traced. The normality ended there, though, as they were much lower in pressure and more intense. Casualties were high this month. The primary tracks were across southern Canada to Iceland, and from the midwestern United States northeastward over and south of Newfoundland to Iceland and the Norwegian Sea. One vicious storm broke the pattern and crossed the North Sea. Only one significant cyclone entered the Mediterranean Sea.

The mean pressure pattern for the month was definitely dominated by the Icelandic Low, located near 60°N, 27°W, with a pressure of 973 mb. This mean must be very close to a record. The normal is 999.7 mb, resulting in a minus 27-mb anomaly, centered with the Low (fig. 40). Not only was the Icelandic Low more intense, the Azores High was higher in pressure at 1027 mb, and covered more area in the east-west direction. The mean pressure over the United States was near normal, with relatively small anomaly centers. There were two positive anomaly centers of interest--a positive 6 mb, centered near 32°N, 53°W, that stretched northwestward over New England, and a positive 7 mb, centered over North Africa.

A large HIGH centered over the north-central United States dominated North America. A front lay across the southeastern United States. Several waves formed and moved northeastward along the front and dissipated. On January 1, one of these developed to sufficient strength to survive and, at 1200, was near Nantucket Island. By 1200 on the 2d, the 998-mb LOW was near Deadmans Point, Newfoundland. The drilling rig

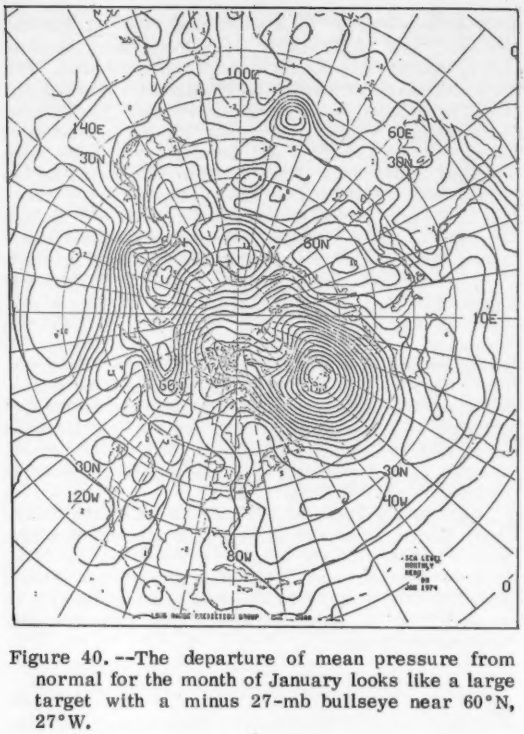

Figure 40.--The departure of mean pressure from normal for the month of January looks like a large target with a minus 27-mb bullseye near 60°N, 27°W.

VGBZ reported 40-kt gales. At 0000 on the 3d, they were hit by 50-kt winds, as was a ship near 45°N, 49°W.

At 1200 on the 3d, the pressure had plunged to 962 mb near 53.5°N, 32°W. The DART AMERICA, near 44.7°N, 45.4°W, was mauled by 60-kt bow winds, driving 20-ft seas, and 30-ft swells. Vessels within 300 to 400 mi of that area combated 40- to 55-kt storm winds and high waves up to 26 ft. Some of them were the ATLANTIC STAR, COLLIN, EUROFREIGHTER, DFQA, KJVG, VC8062, and the VGBZ. Twelve hours later, many of the same ships were still battling the angry elements, especially if they were headed east. The COLLIN now had 60-kt winds. The seas were 33 ft, with 25-ft swells from the west. The CRANIA, 400 mi to the east near 41°N, 35°W, was being battered by 50-kt westerly winds and 36-ft swells and 12-ft seas on her northeasterly course.

Near the center, new centers were forming and moving around each other, becoming the main center as they developed.

At 1200 on the 4th, the pressure of one of these new centers had dropped to 948 mb, southwest of the previous center. These new centers deepened as they moved under the upper-air LOW and dissipated as they moved east and north. Two ships reported 60-kt almost hurricane-force winds, and both were ravaged by 32-ft swells and seas to 15 ft. They were the COMORANT, near 41.3°N, 35.8°W, about 700 mi due south of the LOW, and the DFQA, north of Belle Isle. Other ships reporting 50- to 55-kt winds in a band stretching from the Bay of Biscay to Newfoundland were the AFOUNDRIA, ATLANTIC STAR, IDEFJORD, LASH TURKIYE, MANCHESTER COURAGE, NORSE RIVER, PEGASUS, WESER, FNVD, and the WHDI. The IDEFJORD reported the highest waves near 51°N, 46°W--35-ft seas and 40-ft swells (fig. 41).

The LOW was near 62°N, 24°W, at 0000 on the 5th, at a pressure of 946 mb. Storm winds were still blowing in the southern quadrants, and gale-force winds had now picked up in the northern quadrants. The CETRA COLUMBA now joined the 60-kt exclusive club.

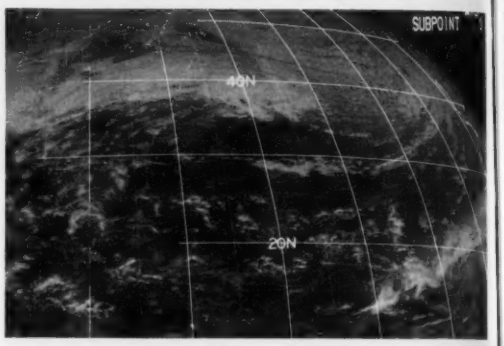

Figure 41.--The LOW is too far north to be positively positioned in this ATS-3 picture at 1544 on the 4th. The long sweep of westerly winds can be visualized in the cloud cover stretching from the United States west coast almost to Europe.

For the next 2 days, ships seemed to either avoid the high wind band or there were no reports in that area. On the 7th, the LOW was slowly filling, and there were more reports plotted. The MABEL WARWICK, at about 47°N, 39°W, found 50-kt storm winds. The 17,189-ton TRENTON, Bremerhaven to New Jersey, had heavy weather damage. On the 8th, the 5LBA was swept by 60-kt winds, south of Kap Farvel. The various LOWs near the center continued to interchange until the 9th, when a new storm came off the continent to become the dominant cyclone.

This new LOW formed north of Minnesota on the 7th. Forty-eight hours later, the LOW (980 mb) was northeast of St. John's. A report, which was probably SEDCO I, indicated 50-kt winds. This 961-mb LOW turned northward and another 970-mb LOW formed near the occlusion prior to 1200. It raced to near 53°N, 25°W, at 961 mb, by 0000 on the 10th. The winds in that 40° to 55°N latitude belt roared again. The drilling platform VC8062 measured 60-kt winds. The ships reporting 50-kt winds were getting too numerous to mention. The C. V. LIGHTNING, at 45.1°N, 30.5°W, was ravaged by 60-kt winds, 16-ft seas, and 52-ft swells. Further north, near 52.5°N, 20°W, Ocean Station Vessel "J" measured 65-kt hurricane-force winds at 1200 on the 10th, and stared into 26-ft seas and 33-ft swells. The winds at Ocean Station Vessel "I" changed from easterly at 55 kt at 0900 to south-southeasterly at 45 kt at 1200. Her pressure was 942 mb, having dropped over 11 mb in 3 hr. At 1200, "I" was very near the center of the

storm. The seas were 25-ft and the swells 39 ft, with the direction indeterminate. The LOW remained near OSV "I" until 0600 on the 11th, when it started to move northward as another LOW moved around the southern edge of the circulation. The minimum pressure was 938 mb at 1200 on the 10th. This LOW had disappeared by 1200 on the 12th.

A high-pressure area moved eastward out of the United States midwest on the 8th and 9th. As it moved off the East Coast, a LOW formed over Chesapeake Bay. On the 10th, the HIGH split into two centers, one over the St. Lawrence valley and the other southeast of Bermuda. The LOW moved between the two high centers, and, at 1200 on the 10th, was near 38°N, 45°W, on the edge of the major cyclonic circulation of the Icelandic Low. The HEILBRONN and TILLIE LYKES were south and southwest of the 1010-mb center with 40-kt gales.

By 1200 on the 11th, the pressure had plunged to 968 mb, a 42-mb drop in 24 hr. The LOW was near 46.5°N, 22.5°W, and pulling the circulation from the last described LOW south of 35°N. An unidentified ship reported being tossed and turned by 60-kt winds and 39-ft seas on her starboard side near 47.5°N, 27°W. Ocean Station Vessel "K" had 40-kt southerly winds which switched to 45-kt westerlies 3 hr later. The WEATHER ADVISOR, at 0000 on the 12th, near 51°N, 15°W, reported 40-kt gales, as did the PEPECAT, near 47.5°N, 8°W. All that day, coastal stations on the west coasts of England and Ireland measured 30- to 40-kt gales. A 90-kt gust was recorded on the Isle of Arran, and a woman was killed near Glasgow when a wall collapsed on her. The Finnish motorvessel MARGARETA, Pasajes, Spain, for Canada, put into Vigo, Spain, on the 13th, to repair heavy weather damage to hatch covers and other damage.

The LOW was tracking north-northwestward into the Norwegian Sea on the 13th, and Ocean Station Vessel "M" was warmed by 40-kt southerlies. Over the cold water and ice near Jan Mayen Island, the LOW disappeared.

Monster of the Month--This marine monster could not be found on the 1200 chart of the 14th with the available data. At 1800 on the 14th and 0000 on the 15th, there was no doubt of its existence. At 0000, it was a well-defined 1006-mb LOW near 43.5°N, 36°W. By 1200, it was 996 mb, at 47°N, 28°W. The GERDA MARIE was 150 mi southwest of the center and hit by 50-kt gales. Two other ships found 40-kt gales, but could not be identified. The storm was headed northeastward toward the United Kingdom and North Sea. Ocean Station Vessel "K" measured 45-kt gales and "J," 35-kt gales, as the storm passed between them. At 1200 on the 16th, the 980-mb LOW was over Ireland. A Russian ship reported 55-kt storm winds and 30-ft seas at 49.1°N, 11.2°W. The ATLANTIC CHAMPAGNE radioed 60-kt violent winds near 49°N, 16°W, but there were no seas plotted (fig. 42).

These destructive winds were an indication of what hit both sides of the English Channel that day and the next. Winds were reported as high as 87 kt (100 mph) and seas up to 50 ft battered both sides of the channel. British authorities reported at least 25 dead and 5 missing. French officials said at least nine persons

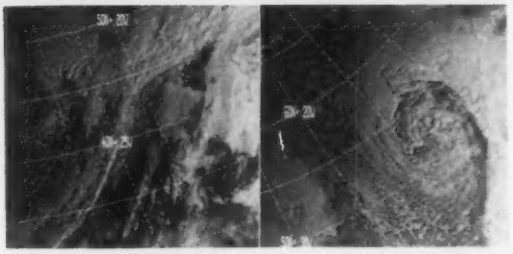

Figure 42.--The approximately 24-hr change in the position and structure of the LOW can be seen in these NOAA-2 pictures on the 15th and 16th, left to right. The cloud cover is not as bright as usual because of the low sun angle.

died on the continental side of the channel. At least eight small ships capsized or were blown into reefs in the high seas. Many homes were damaged and grounded powerlines blacked out thousands of homes on the east coast of England. Dunkirk and other coastal cities reported heavy damage. The West German coast was lashed by winds over 50 kt, and roofs were blown off as far inland as Duesseldorf.

The 2,088-ton Cypriot freighter PROSPERITY was blown aground on a reef off Guernsey and broke up, with the loss of 18 men aboard. Another eight seamen drowned and three were missing when the 781-ton Danish MERC ENTERPRISE (fig. 43) capsized off the coast of Devon. In Exminster, along the same coast (fig. 44), a giant wave washed a 13-year-old boy out to sea and he drowned. Six fishermen and a 16-year-old girl perished off Brest when waves overturned three small boats. A crewman was washed overboard and lost from the Swedish cargo ship ELIZABETH (494 tons). Off the Netherlands, helicopters rescued seven crewmen from the Lebanese coaster CORDELLA, after it ran aground on a sandbank. Another Cypriot ship, the MARTA (2,240 tons) reported a fire off the Belgian coast, which took one life. A French trawler, the KERIOLET, radioed a distress call off the Bristol Channel. The ELWOOD MEAD (59,200 tons) still lay stranded over her full length on a reef off Guernsey. This may have been the storm that caused heavy weather damage to the British DART AMERICA (31,036 tons) on her Antwerp to Halifax voyage.

At 1200 on the 17th, the LOW was over southern Sweden and, on the 18th, moved through Poland to disappear in Russia. Strong winds and high seas continued as they swept around the general Icelandic Low circulation with a long fetch. On the 18th, high pressure moved into the Bay of Biscay, moving the strong circulation northward.

This storm formed east of Cape Cod on the 17th, on a front connected with a LOW which was over Kap Farvel at that time. Strong storm winds of 40 to 50 kt were already associated with that LOW. The center raced eastward and, by 0000 on the 18th, was 982 mb, near 44.5°N, 44.5°W. The WILLIAM R. ADAMS, just a few miles from the center, near 43°N, 47°W, reported a roaring 80-kt wind from the east. The wave heights were missing from the plotted and teletype report. At the same time, the ATLANTIC COG-

Figure 43.--Sea King helicopters from the Royal Navy station at Culdrose, Cornwall, hover over capsized Danish freighter MERC ENTERPRISE before she sank in storm-lashed seas off the South Devon coast on January 16. Seven survivors were snatched from the sea. Another five were drowned, and three presumed drowned. United Press International Photo.

Figure 44.--Surf crashes against breakwater at Dawlish, South Devon, on January 17, where 13-yr-old Stephen Cutts was washed out to sea and drowned, during furious gales and high seas which hit Britain's south coast. Ships sank and floods occurred in places which were the worst for many years. United Press International Photo.

NAC, southwest of the center near 40.5°N, 59°W, came up with a 90-kt report on the chart, which did not exactly agree with her 10-ft seas report. There may have been some garbling between the taking and the plotting of the weather. The BLEXEN, south of the center near 38.5°N, 45°W, was battered by 55-kt winds and 23-ft waves.

The LOW moved northeastward, deepening to 970 mb near 51°N, 39°W, 12 hr later. SEDCO J measured a roaring 60-kt wind and the C. P. DISCOVERER found the same isotach east of the LOW near 50.5°N, 29.5°W. She also reported 43-ft seas and 26-ft swells. There were 40- to 50-kt reports in all directions except north of the center. By 1200 on the 19th, the LOW was a 965-mb depression near 58.5°N, 34°W. The ATLANTIC CHAMPAGNE, about 900 mi to the south near 45°N, 35°W, was hit by 60-kt winds and 33-ft seas.

On the 19th, a LOW moved eastward over Nova Scotia and another LOW formed south of the main center. These two sapped the strength of the old LOW as it stalled south of the Denmark Strait and disappeared on the 21st.

This was the LOW mentioned in the paragraph above that moved over Nova Scotia. It had its beginning over the State of Indiana early on the 19th. By 0000 on the 20th, it was a 986-mb depression south of Sydney, The CAVALA reported 40-kt gales and 15-ft waves south of Sable Island, which also recorded 40-kt gales. Twelve hours later, SEDCO I was pounded by 50-kt winds and confused waves up to 12 ft. The ATLANTIC CHAMPAGNE was again swept by 60-kt winds and 30-ft seas and swells, about 420 mi south of the 971-mb center, which was near 51°N, 42°W, at 0000 on the 21st (fig. 45). The TACOMA CITY, at 45°N, 36.5°W, was mauled by 60-kt winds and 25-ft seas and swells just east of the cold front. Forty- to fifty-knot winds were common occurrences between 45° and 50°N and 20° to 50°W. This LOW forged its way as far north as Iceland before splitting into two centers, one on each side of the island.

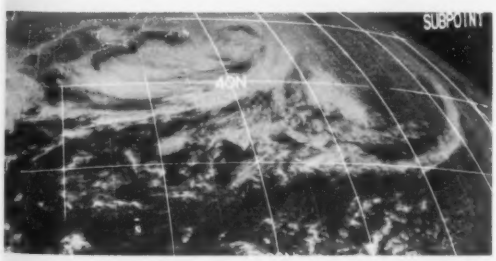

Figure 45.--The cloud cover with this LOW fits the classical pattern. The TACOMA CITY was hit by 60-kt winds 4 hr after this picture.

A LOW developed over Missouri late on the 26th and moved northeastward across Lake Huron. By 0000 on the 28th, about 30 hr later, it was over the Gulf of St. Lawrence at 983 mb. SEDCO H radioed that the winds were blasting it at 60 kt. They weren't nearly as bad off as the observatory atop Mt. Washington in New Hampshire. They recorded an average speed of 64-kt with maximum gust of 122 kt, on the 27th, as the LOW passed to the north. That was the highest average speed and gust for the month, although they had gusts over 100 mph on 10 days of the month. At 1200 on the 28th, the 974-mb LOW was near 50°N, 44°W. The SATSUMACORE, at 43.1°N, 44.4°W, was struggling against 60-kt storm winds. The DART AMERICA had no less a struggle as the front passed near 44°N, 40°W, with 55-kt winds and 16-ft seas riding 40-ft swells. The ONOMICHI MARU was in unfriendly foreign waters just south of the center, with 50-kt gales and 16-ft seas and swells. There were three major LOWs between Newfoundland and Norway at this time. Gale- and storm-force winds were reported from shore to shore. The 4,576-ton Greek motorship CAPTAYANNIS dragged anchor on the Clyde, struck the 22,783-ton British tanker BRITISH LIGHT and holed her, then grounded and lay half submerged in heavy seas. Twelve hours later, the DART AMERICA still fought 55-kt winds and the swells had increased to 46 ft. This LOW had traveled a more southerly route, but eventually turned northward to stall and dissipate just south of Iceland by February 1.

This was another contribution the United States midwest made to the Atlantic this month. It started late on the 27th and was the next system after the previous one to take to the sea. The LOW moved off the coast near Long Island about 0600 on the 29th. Several ships found a mere 40-kt wind as it moved over the Banks to Cape Race.

After passing from over the Labrador Current to over the Gulf Stream, it deepened rapidly to 973 mb, near 48°N, 39°W, at 1200 on the 30th. The INO-A, at 43°N, 40°W, was buffeted by 60-kt winds and 26-ft seas. As the storm raced eastward, the LE SAVOYARD, at 0000, had a 60-kt glimpse of what was to come later in the day. The seas were 40 ft. At 1200, the BABETTE JACOB, near 43°N, 22°W, and the BEI-HUDSON, near 42.7°N, 21.7°W, were both ravaged by 65-kt hurricane-force winds. The BEI-HUDSON reported 20-ft seas and "71-ft" swells. The MOORDRECHT, near 44°N, 29°W, had only 45-kt gales, but was being hounded by 52-ft following seas. Thirty- to forty-foot waves were a common report in the southwest quadrant of the LOW. Ocean Station Vessel "K" was tossed by 40-kt winds and the seas had built to 39 ft. Twelve hours later, "K" had 45-kt westerly winds, 46-ft seas, and 16-ft swells from the southwest.

The LOW was moving slowly towards the northeast on the 2d. The EWMR was hit by 50-kt gales south of Iceland and west of Scotland. Later in the day, the THERON, off Portugal, was also in the 50-kt wind band. The LOW moved to near the Shetland Islands on the 3d and dissipated.

The ancestry of this LOW is traceable back to Montana, early on the 30th. It formed slightly on the back side of the upper-air trough and under the jetstream. Its development was rapid, and it raced eastward with the zonal flow. At 1200 on the 31st, it was south of James Bay at 985 mb and the circulation had reached the Northeast. That day, some coastal stations reported the fastest wind for the month. The time of day was not reported, but was probably late, as the wind

direction was northwesterly. Blue Hill Observatory, Mass. (629 ft), had 62 kt, and the forecast office at Boston had 53 kt.

On February 1, the 962-mb LOW had moved into Labrador and the strong winds were behind the cold front, out of the northwest. The GYPSUM QUEEN had 60-kt winds just south of Cape Sable. The VC8062 reported 70-kt winds, and, although the direction was wrong, the speed seemed reasonable considering the other reports and the pressure gradient. North of Sydney, the CRYOS had 50-kt gales. On the 2d, 50-kt winds were reported from Cape Sable north to Ocean Station Vessel "B," which fought 55-kt winds from the southeast. Kap Farvel was swept by 60-kt gales.

The pressure had decreased to 952 mb early on the 2d, but was rising on the 3d, as the LOW moved northeastward over the Labrador Sea. A new center developed near Kap Farvel on the 3d, and the original center became stationary over the Labrador Sea and disappeared on the 4th.

This was a very bad month around the Mississippi River Delta and southern Louisiana, including New Orleans, for fog. Cold water from the river, near 40°F, fans out through the delta to the east, south, and west, and spreads along the coast. There is more of this cold water this year than normal, for there has already been flooding along the river. When warm, moist air flows northward from the Gulf of Mexico over this cold water, dense fog occurs and spreads inland. When the wind conditions are light and over the colder ground, the fog often persists for long periods.

During the period of January 7 to 20, there were several days of heavy fog. During the first week, there were 112 ships delayed and 78 ships delayed the second week, on both sides of the passes at the mouth of the river. The high water and swift currents intensified the problems as more than 150 barges broke loose in the Port of New Orleans, in three separate incidents, causing damage to ships and docks before they were secured. Figure 46 shows a few of the 131 barges that broke loose on the 16th and floated down the river. Eighty-four reportedly held grain, some were empty, but one contained fuel oil. New Orleans main bridge was closed, as was ferry service. Three wharves and several ships were damaged, including the USCGC POINT SPENCER. Grounding was a common occurrence, as the fast currents changed channels and fog made navigation difficult. There were six groundings noted during this period alone that were probably at least partially attributable to fog.

The 22,311-ton Norwegian ore carrier BAUNE, loaded with bauxite, and the 11,476-ton United States tanker KEYTRADER collided (fig. 47) on the Mississippi River near Venice, La., on the 17th. Both vessels caught fire (fig. 48), and burning fuel oil floated down the river. Five crewmen were killed, eight injured, and eleven missing. Fog hindered the rescue operations. On the 23d, the Greek motorvessel THEANTO A.S. (9,602 tons) ran aground on soft sand at low tide in fog. To the east of the Mississippi Delta, the Japanese NICHIKU MARU grounded in the Mobile Ship Channel on the 22d, in dense fog. On the last day of the month, the TEXACO

Figure 46.--Runaway barges that broke loose in the fog on the Mississippi River on January 16 lie jammed against a floating oil rig which they struck as they raced downriver. Note the tugboat, caught in the squeeze from the fourth barge to the right. Wide World Photo.

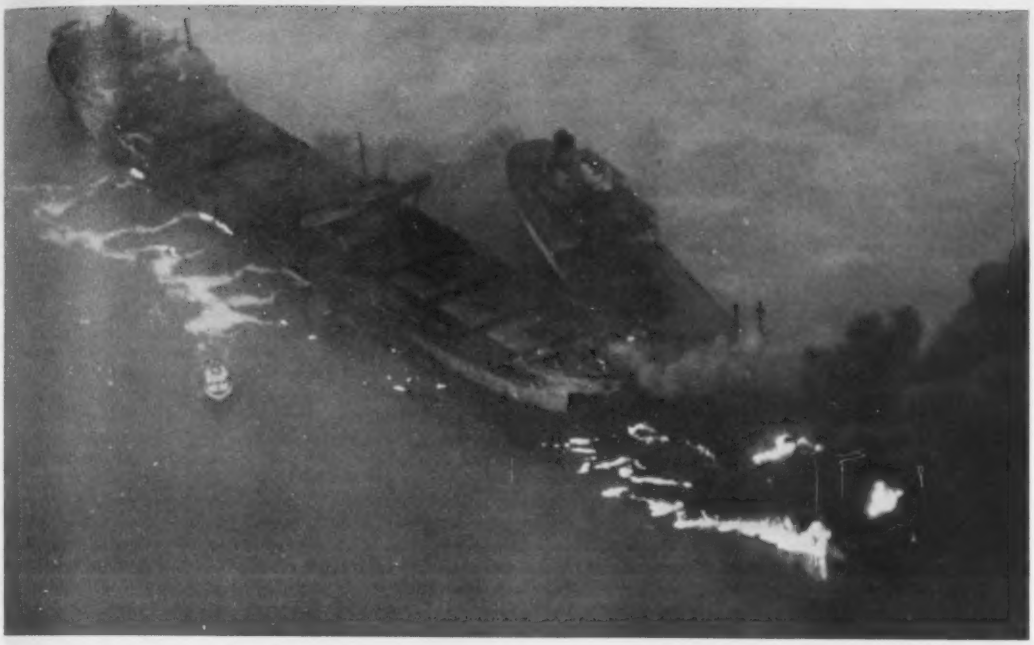

Figure 47.--Black smoke and flames cover the water near the collision point of the KEYTRADER and the BAUNE.

Figure 48.--Firefighters direct water at the burning tanker KEYTRADER. The ship, loaded with 18,000 tons of fuel oil, exploded in flames after the collision. Wide World Photo.

Figure 49.--Damage to the starboard boat deck of the GULFSPRAY after her collision with the KOLLGEIR. The force of the collision is graphically illustrated by the depth of penetration. Florida Times-Union Photo.

FLORIDA (12,802 tons) ran aground in the southwest pass of the Mississippi River in fog, which stopped all movement in or out of the river port.

Casualties--This was not a good month. Fog took its toll in other areas besides the Gulf Coast. The United States tanker GULFSPRAY (18,150 tons) and the Norwegian motorship KOLLGEIR (20,455 tons) collided in fog (fig. 49) about 4 mi from the mouth of the St. Johns River. The GULFSPRAY went aground about 1/4 mi off Mayport, Fla. The Liberian-registered ARIZONA, on a voyage from Canada to Jamaica with a cargo of steel, arrived in Georgetown, S. C., with number 2 tween deck collapsed, due to heavy weather.

The motorvessel DETROIT EDISON and the steamship HENNEPIN were both stuck in ice and possibly aground 9/10 mi north of the Detroit River Light in Lake Erie. Both were downbound and were freed on the 9th, proceeding to Toledo for winter layup.

The South African motorvessel S. A. WELTEVREDEN (7,002 tons) hove to in a storm and the deck cargo shifted, about 350 mi southeast of Philadelphia on the 10th. The Panamanian-registered CAPE BRETON arrived in Jacksonville from Antwerp on the 22d, with heavy weather damage. The Greek KEA (13,000 tons) ran out of fuel in the Atlantic. It broke its towline in heavy seas on the 15th, about 210 mi southeast of Norfolk.

The 7,782-ton Greek steamer IRA and the 8,768-ton Uruguayan motorship TACUARI collided at Haifa in stormy conditions on the 29th.

Two persons drowned and four were rescued when the 61-ft schooner SADIE AND EDGAR struck a sandbar and broke up off Atlantic City, N. J. The tanker PROVIDENCE GETTY spotted the four in an 11-ft skiff and rescued them.

Rough Log, North Pacific Weather

December 1973 and January 1974

ROUGH LOG, DECEMBER 1973--The cyclone tracks were above normal this month, with more than the usual number of short-lived storms. The cyclones that traveled from the western to the eastern Pacific tracked further south than normally. The number of storms that entered the Gulf of Alaska and those that passed onto the West Coast was much above normal. Many of these formed in the eastern half of the ocean. There were several large LOWs that dominated the northern ocean for days. Several LOWs brought heavy rain and snow to the U.S. west coast.

The pressure pattern was fairly normal according to climatology, except the centers were offset and more intense. The Aleutian Low, 1001.3 mb according to climatology, normally is an elongated oval centered along approximately 55°N between Unimak Island and the Kamchatka Peninsula. This month, there were two centers offset to the east, with the lowest pressure being 992 mb. The 1021-mb high-pressure cell that extends southwestward from the U.S. west coast was 1024 mb and south of its normal position. A trough line along 157°W, which usually isn't present, reflected the storms that originated south of the Gulf of Alaska. Higher pressure over Asia resulted in a tight gradient over eastern Siberia.

The anomaly centers were the opposite in the North Atlantic. A large minus 13-mb center was positioned in the Gulf of Alaska near 53°N, 145°W. Another negative 9-mb center was near 52°N, 180°, and a third minus 6-mb center was over the Sea of Okhotsk. A positive 6-mb anomaly was west of Baja California near 28°N, 128°W, and a positive 3-mb circular center was near 30°N, 180°. There were two large positive 15-mb anomaly centers in central Asia.

There were no tropical cyclones in the North Pacific during December.

This was one of those LOWs that appear to explode fully developed out of nowhere. Actually, this is not true, as probably a more dense network of observations taken more often would have identified and located it earlier.

The LOW developed near 49°N, 176°E, on a front that extended out of another LOW just off the Kamchatka Peninsula on the 1800 chart of the 1st. At 0000 on the 2d, it had a pressure of 978 mb. This tightened the pressure gradient between the LOW and a HIGH to the south, and the TAKAO MARU and the TEMPLE INN both reported 40-kt winds along 45°N. By 1200, the pressure had dropped to 962 mb near Adak Island. No winds greater than 30-kt were reported, but the pressure gradient measured 100 kt on the geostrophic wind scale in areas of no reports.

On the 3d, the HAKUKO MARU was buffeted by 45-kt gales and 28-ft swells near 51.5°N, 170.5°E. The ROKKOHSAN MARU also reported 45-kt gales, near 50°N, 174°W, but she was swamped by 46-ft seas and 46-ft swells from the west while trying to make headway toward the west-southwest at 10 kt. The report from the ATLANTIC NEPTUNE of 60-kt at 43°N, 176°W, was suspect due to transmission errors.

At 0000 on the 4th, as the LOW crossed the Aleutian Islands, two LOWs developed, the new one over 400 mi to the east. By 1200, the old LOW had deteriorated to a trough and the split had weakened the stock to such an extent that, by the 5th, it was no longer listed on the board.

A large area of generally weak pressure was located off Japan and over the Sea of Okhotsk on the 6th. On the 7th, a 998-mb LOW developed near 42°N, 151°E. Adjustments in the wavelength pattern in the upper-air circulation was occurring at the same time, resulting in energy for increased cyclonic circulation. The NANSHO MARU, near 49°N, 170°E, east of the center, reported 40-kt winds and heavy rain. The AMERICAN LYNX, at 36°N, 148°E, southwest of the center, also had 40-kt gales and lightning.

By 0000 on the 8th, the pressure had plunged to 967 mb, with the center at 50.4°N, 159°E. A 55-kt wind was reported just off the Kuril Islands. The CHUET SUSAN MARU and the GYOKUYO MARU were lashed by 40-kt gales, with seas and swells up to 15 ft. At 1200, the NANSHO MARU had traveled to 47.1°N, 163.9°E, and was being mauled by 70-kt westerly "winds" and 10-ft seas riding 32-ft swells. The DAIKEI MARU and the JAPAN MAPLE, 360 and 640 mi south of the center, respectively, were being bounced around by 45-kt gales and seas to 15-ft.

On the 9th, the storm turned easterly along 54°N, under the influence of the zonal upper-air flow. The central pressure had started to rise slowly as it moved out of the major energy source. The KINKO MARU, south of the Near Islands, was headed into 50-kt gales and 20-ft swells. On the 10th, the NANSHO MARU was still engaged with 50-kt winds, and now 25-ft swells with 21-ft seas. For the next few hours, no ships reported in the strong wind area, but at 0000 on the 11th, the JUNEAU MARU, south of Amchitka Island, struggled with 55-kt winds.

As usual in the Pacific, the reports for 1200 were sparse. At 0000 on the 12th, the LOW was near 50°N, 153°W, and the pressure decreasing as it gained new energy. Even so, it was to lose out to another LOW which had raced out of the southwest and weighed in at 958 mb. The HAWAII, at 43.5°N, 158°W, was pounded by 50-kt winds and 48-ft seas. To the northeast, near 45°N, 156°W, another ship also had 50-kt winds, but the seas and swells were 15 and 23 ft respectively. West of the center, near 50.5°N, 165°W, the DAISHOWA MARU (a ship whose reports we continually see on the charts) found 55-kt storm winds and moderate waves.

The new LOW center passed almost directly over Ocean Station Vessel "P" at 0000 on the 12th. The editor would be interested in obtaining a barogram trace for that time. Twelve hours later, the new LOW had taken over the circulation and recorded a pressure of 954 mb at 52.5°N, 142°W. Ocean Station

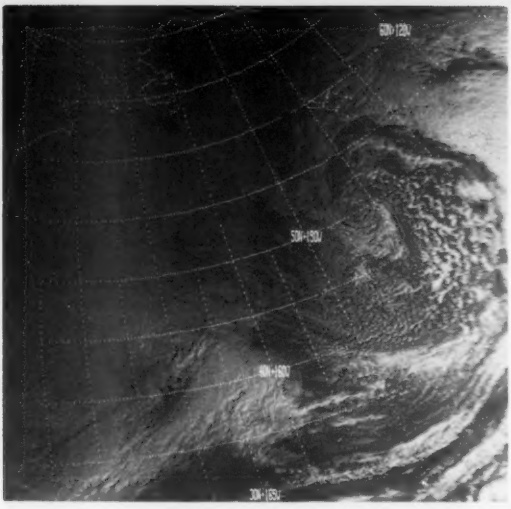

Figure 50.--The LOW is well past Ocean Station Vessel "P," as the cold front heralds the high winds and waves that were pounding the Oregon-Washington coast.

Vessel "P" measured 40-kt winds and 23-ft seas. Far to the southwest, near 39.5°N, 152°W, the PRESIDENT POLK raced with 50-kt winds. At the same time, a ship coded as WEBR, but which was probably the HAWAII, near 43.5°N, 158.5°W, was hammered by 40-kt gales and 36-ft seas.

High wind and coastal flood warnings were issued along the State of Washington coast on the 12th, with gusts to 65 kt. Cape Blanco, Oreg., reported winds averaging 55 kt. Later in the day, it reported 73-kt winds (fig. 50).

On the 13th, the LOW began filling and the winds decreased. The LOW center circled around in the Gulf of Alaska and turned northwestward to end its existence over Kodiak Island on the 16th.

Between the 13th and 16th, several relatively small but intense LOWs moved around the southeastern edge, to strike the North American coast. On the 15th, one of these caused 50- to 60-kt winds along the Washington Coast. Heavy seas caused the 8,573-ton Greek freighter ARISTAGELOS to divert from 700 mi northwest of San Francisco to Coos Bay with U.S. Coast Guard escort after her cargo of beans shifted, causing a 10-degree list.

This was another of those explosive developments. A col area of about 1014 mb lay east of Tokyo and west of a high-pressure area at 1200 on the 10th. On the 0000 chart of the 11th, a well-developed 1006-mb LOW was near 36°N, 156°E, and the JGOW reported 40-kt gales on the west side. The LOW moved northeastward, deepening 30 mb in 24 hr. The MARUSUMI MARU and another ship reported 45-kt gales north of the center.

The storm turned northward and, at 1200 on the 12th, the JUNEAU MARU, near 50°N, 169.5°E, just south of the center, was tossed by 60-kt winds from the northwest, with 10-ft seas and 50-ft swells from the southeast. Twelve hours later, she still was battling 55-kt winds, but the seas and swells had calmed. The SHOKAI MARU, 120 mi due south of the center, had a 50-kt crosswind driving 33-ft seas. The LOW continued its northerly track, filling over the cold water of the Bering Sea, and, by the 14th, had disappeared.

This LOW formed at the apex of an occlusion, near 42.5°N, 159.5°W, at 0600 on the 15th. Minimum gale-force winds were found on the west and south sides of the LOW on the 16th, but it did not appear the LOW would develop into a significant storm, as there were a minimum of five LOWs east of 180° and north of 40°N. Small waves and LOWs were forming and dissipating in 12 to 36 hr.

At 0000 on the 17th, the 985-mb LOW was near 50°N, 147°W. Ocean Station Vessel "P" measured 65-kt hurricane-force winds. At that time, the diameter of the major circulation of the storm was only 300 to 400 mi. The LOW continued a northerly track and, by the 18th, blended into another LOW approaching from the south.

This was another of those small, intense LOWs, like the previous one. It formed on the same polar front, north of the Hawaiian Islands, as a wave on the 16th.

An upper-air LOW was over Bristol Bay, with the major trough extending almost due south. As minor waves traveled around the trough, these surface LOWs formed and raced up the leading edge of the trough.

Twelve hours after forming, at 1012 mb, the LOW had a pressure of 992 mb, near 31.5°N, 157°W. The TOYOTA MARU No. 10, about 300 mi west of the center, was swept by 50-kt winds. Nearby, the ZENKOREN MARU had 40-kt gales. Just north of the center, the ARCA had heavy rain and 40-kt gales.

This LOW also traveled northward, as did the prior storm. At 0000 on the 18th, it was near 41°N, 145.5°W, with a much larger circulation than the previous storm. The following ships reported 40- to 45-kt gales: GUAM BEAR, HAWAII BEAR, LETITIA LYKES, TAINING, USCGC DILIGENCE, and YAMAMIYA MARU. This LOW also passed almost directly over Ocean Station Vessel "P," about 1500 on the 18th. Her maximum synoptic time winds were 35 kt, but for over a 6-hr period after the center passed, the waves were very confused. The 2100 report indicated northwest (310°) 5-ft seas, 21-ft swells from 120°, and 12-ft swells from 190°. The 0000 report on the 19th had 15-ft seas from 310° and 21-ft swells from 120°.

The pressure gradient between the LOW and the West Coast was very tight, as the isobars were north-south oriented against a HIGH over the Canadian Plains. Coastal stations were not indicating high winds, and there were few coastal ship reports. Early on the 19th, the 10,059-ton Liberian freighter ORIENTAL MONARCH sank about 500 mi west of Vancouver. She reported taking on water after engine trouble. Newspaper accounts reported winds of 60 kt and waves of 30 ft in the area. All crew members were lost.

A LOW with its associated fronts, that had a pressure of 970 mb as it moved across the Baltic Sea from the

Atlantic, barely managed to survive the trip across Siberia, an area of almost continuous high pressure. The high-pressure cells moved south and split as the cold front moved eastward. By the time the front approached Manchuria, it was barely identifiable. On the 19th, the Siberian High began to build again, and one of the high-pressure cells had moved across the Yellow Sea, where it began to pick up moisture. The Siberian High had built to 1066-mb by the 20th and was bringing cold, dry air from the north down over Manchuria and China. The front rapidly regenerated with the temperatures and moisture contrast over the coast. With the attendant energy, a 1017-mb LOW also developed, by 1200 on the 20th. By 1200 on the 21st, it was 988 mb, over the Sea of Japan. Twelve hours later, it was 968 mb, and a station on the mainland on the Tatar Strait reported an 80-kt blizzard. Ostrov Urup in the Kuril Islands reported a 50-kt storm.

Ahead of the cold front in the warm sector, three ships reported 40-kt gales in the 22d. They were the HOWA MARU, MEISHUN MARU, and the PACIFIC BEAR. On the 23d, the SYUKO MARU found 50-kt gales near 43°N, 150°E. Small LOWs were developing and moving around the periphery of the storm. One of these almost stole the whole show and, on the 24th and 25th, was a deeper storm than the main LOW. The combined cyclonic circulation covered most of the North Pacific north of 30°N. Thirty-five- to forty-knot winds were scattered over the area.

At 1200 on the 25th, the 961-mb LOW was near 44°N, 175°W. The HOWA MARU was sailing about the same direction and speed as the LOW and, near 42°N, 177°W, was hit by 55-kt winds. Late on the 25th, the LOW turned northward and treated the Alaska Peninsula to 50-kt gales on the 26th. The PHILIPPINE MAIL, 500 mi south of the center, had relatively calm 40-kt winds, but was battered by 36-ft swells. The higher winds were now from the south, ahead of the front. At 1200 on the 26th, the ALEX SERAFINOVICH encountered 50-kt winds just prior to passing through the frontal zone. Northwest of the LOW, which now had moved into the Bering Sea, Mys Navarin was frozen by minus 8°F winds of 80-kt that continued for over 24 hr. The central pressure had dropped to 940 mb. The center was moving northwestward and filling. It returned to the desolate waste of eastern Siberia late on the 28th and died on the 29th.

The frontal systems had moved far out on the edge of the large LOW described above. Frontal waves were forming and moving around the edge, some more intense than others. This storm formed on the 29th, in the central ocean near 32°N, 162°W, in a col area between two HIGHs. The high-pressure center off the U.S. west coast was essentially stationary, while the one over the western half of the ocean was moving eastward and northward. This increased the circulation and cyclogenesis.

On the 30th, the HIGH was being squeezed like a giant bladder between this LOW and another that was moving northeastward off the Asian coast. On the northwest side of the LOW, the AMAZON MARU, FEDERAL NAGARA, GEH YUNG, and the PIONEER MOON reported 35- and 40-kt gales.

As the high-pressure area moved northeast of the LOW, it combined with the high-pressure center off the U. S. west coast, with a 1042-mb center in the Gulf of Alaska. This blocked the movement of the LOW, and it turned northwestward on the 31st. The KOWLOON BAY reported 35-kt gales and 23-ft swells with 15-ft seas, north of the center near 35°N, 163°W, The SPRAY CAP, at 30°N, 152°W, east of the 981-mb center, struggled with 65-kt winds on her port side. The observation did not include a report on the state of the sea. On January 1, a new LOW approached from the southwest and became the predominant storm on the 2d.

Casualties--The Liberian bulk carrier REGENT LOTUS (8,476 tons) went aground in Toyama Bay after turning back because of heavy weather. The 10,421-ton SILVER CONSTELLATION deviated to Wake Island because of hull leakage as a result of heavy weather. The Greek motorvessel LOUCAS N. returned to Victoria, British Columbia, to restore lumber deck cargo which shifted in heavy weather. The captain and chief mate were lost overboard from the 35,589-ton CHEVRON MISSISSIPPI during a storm in the Gulf of Alaska. A third man was fatally injured while attempting to lash down gear.

ROUGH LOG, JANUARY 1974--The number of cyclones this month was above normal, and the paths their centers traced were confused. The best that can be said of their comparison with climatology is that the general direction of travel was from west to east. Many did not hold to that rule, either, as they curved northward, northwest, and circled. Also, the concentration of tracks was much further south, especially in midocean.

A look at the 30-day anomaly sea-level pressure chart (fig. 40) in comparison with the climatic mean would immediately indicate that the cyclone tracks would not be normal. Since weather is a global function and continuous, one could not expect that the North Pacific would be normal when the North Atlantic was so abnormal. The 1000.4-mb Aleutian Low is normally Low was 992 mb and centered near 44°N, 168°E. The high-pressure ridge extending seaward from both coasts was near normal, but the High over central Asia was about 8 mb above normal.

There were two major negative anomaly centers--a minus 12 mb near 40°N, 170°E, and a minus 10 mb near 38°N, 163°W. There were three positive anomaly centers that directly affected the weather of the North Pacific. They were a plus 4 mb in the Gulf of Alaska near 50°N, 145°W, a plus 12 mb over eastern Alaska, and a plus 19 mb north of the Kamchatka Peninsula.

There was one tropical cyclone this month in the western North Pacific, tropical storm Wanda. As last year, the first tropical cyclone started with a "W," with 1973 producing exactly the same number of cyclones as the list of names.

The pressure pattern over the North Pacific during this week of the month was very diffuse, with many small and weak circulation systems. A new 1002-mb cyclonic circulation developed on the 4th and consolidated some of the confusion. The wave moved rapidly east-northeastward with light winds. As it deepened and the radius of circulation increased, so did the winds. By 1200 on the 5th, there were three reports

Figure 51.--The KAKO MAUR was battling near-hurricane-force winds under this picturesque spiral cloud pattern.

of 40-kt gales west and south of the center. They were from the DAIAN MARU, WYOMING, and the JFZG. Twelve hours later, there were gale-force or greater reports in all directions from the center. The DAIAN MARU was now being buffeted by 50-kt winds with 33-ft seas and swells. The ANDES MARU, NORWAY MARU, and the WINDFORD all found 45-kt gales in various quadrants around the storm, with seas averaging 25 ft.

At 1200 on the 6th, the ANDES MARU, at 37°N, 172°W, about 160 mi due west of center (37°N, 169°W), fought 50-kt winds, as did the WYOMING, which also reported 36-ft seas. At 0000 on the 7th, the KAKO MARU, near 31°N, 167°W, was headed into 60-kt winds, 26-ft seas, and 30-ft swells (fig. 51). The USNS FURMAN, due west at 31°N, 173°W, fought 50-kt winds, 20-ft seas, and 36-ft swells. The JOHAN U. was not to be outdone, when she reported 50-kt winds, 33-ft seas, and 39-ft swells at 1200. Waves up to 18 ft high crashed against Oahu's north shore (cover picture).

The 976-mb LOW turned northward on the 8th and then northwestward on the 9th. Cyclonic circulations were forming and moving around the southern periphery of the LOW. This generally weakened the gradient, and fewer high winds were reported.

One of these was to become a fairly strong storm itself. The LOW moved over the Aleutian Islands and entered the Bering Sea, where it disintegrated. Meanwhile, back on the 7th, the new LOW formed at the point of occlusion of a frontal system and moved out of the circulation of another major LOW. It tracked eastward until, on the 9th, it was near 33°N, 161°W, and producing 40-kt winds. On the 10th, the MOBIL ACME and the KNFD both encountered 50-kt winds. On the 11th, the storm reached its lowest pressure of 970 mb. It too turned northward and then westward, to be replaced by another system on the 12th.

At 0851 January 10, a 7.5-magnitude earthquake occurred near 14°S, 167°E. This was in the New Hebrides Islands in the South Pacific Ocean, about 1,400 mi northeast of Brisbane, Australia. It was the second major quake in the area in 2 weeks. No reports of tsunamis or seismic waves were found.

On the 12th, there were two major cyclonic circulations, plus tropical storm Wanda, over the North Pacific. South of the col area, between the two extratropical storms, this LOW was born, at the low pressure of 985 mb.

It almost immediately took over the circulation of the eastern cyclone. At 0000 on the 13th, the 972-mb LOW was at 40°N, 156°W, and the KBAJ reported 45-kt gales southwest of the center. In the next 24 hr, the LOW made a loop in the area of 40°N, 155°W. The RHETORIC was south of the center and was hit by 50-kt winds. There were also reports of seas up to 20 ft and one report of swells up to 33 ft.

The strongest winds developed by this storm occurred on the 15th. At 0000, the VANESSA, at 40°N, 139°W, and the CHEVRON CALIFORNIA, far to the southwest at 27°N, 146°W, had roaring 55-kt winds. Ocean Station Vessel "N" was rocked by 50-kt winds and washed down by heavy rain as the front passed. Later in the day at 1200, the HAWAIIAN CITIZEN bucked 60-kt storm winds at 38°N, 137°W, about 240 mi south of the LOW. Winds along the West Coast were fairly strong. NNCR reported 55-kt winds at the mouth of the Columbia River. To the south, off Cape Mendocino, a ship reported 40-kt gales, and there were two reports off Vancouver Island. Heavy rains were falling all along the West Coast, and flood warnings were posted in California and Oregon.

Other LOWs were forming on the edge of this LOW. A small LOW persisted over the Strait of Juan de Fuca for several days, and, on the 15th, another formed in the Gulf of Alaska. On the 16th, the original LOW was approaching the coast of Washington State. NNCR reported 55- to 40-kt winds and storm warnings for 60 kt were posted along the northern part of the U. S. coast. Gale winds stretched from the coast halfway to Hawaii. The LOW rapidly weakened as it approached land, and, by late on the 16th, the major circulation was the LOW in the Gulf of Alaska, which had remained quasi-stationary.

As the previous LOW moved eastward, a LOW which had moved eastward to 170°E turned northward and then westward, leaving a large area of weak pressure gradient in midocean. A ridge of high pressure was pushing down from the north and spreading westward. This helped develop a circulation, and, at 1200 on the 15th, a 997-mb closed LOW was analyzed near 35°N, 175°W. It quickly intensified and, at 0000 on the 16th, the DELWIND was suddenly fighting 40-kt gales. By 0000 on the 17th, the 976-mb LOW was at 37°N, 157.5°W, and the JGIR, about 400 mi to the southwest, found 50-kt winds.

The LOW was racing for the U.S. west coast. The REINHART LORENZ RUSS was blown by 45-kt gales. Many other ships had 35- to 40-kt gales, south and southwest of the center. As the LOW approached the coastline on the 18th (fig. 52), it turned and paralleled the coast, thus avoiding oblivion over the coastal mountains. At 0000 on the 19th, its pressure

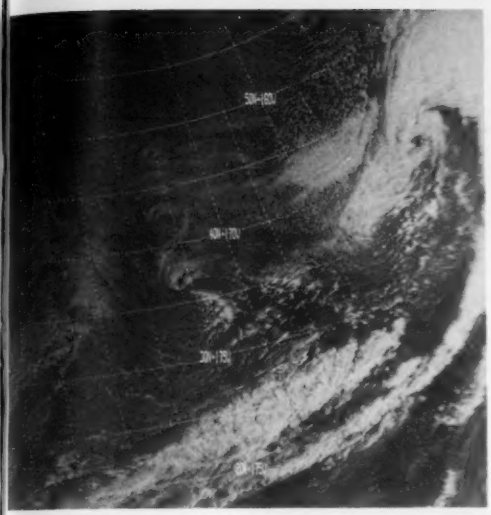

Figure 52.--This powerful storm wrought havoc along the West Coast. Its cold front is sharply outlined along the edge of the picture.

was 966 mb, and, a few hours later, it had absorbed the stationary LOW that had waited in the Gulf of Alaska. At 1200, the PHILIPPINE MAIL, at 54°N, 154°W, was tossed by 55-kt winds and 18-ft seas and swells. The GALVESTON probably wished she were back on the Gulf Coast as she was hit by 45-kt gales, snow, and 20-ft swells. This LOW now stalled in the Gulf of Alaska and was dissipating rapidly, finally disappearing on the 20th.

These storms caused millions of dollars damage in the five Pacific Northwest States. The death toll stood at 14. Mudslides, washout, and flooding took lives and closed major highways and railroad lines.

This was one of the few storms that tracked across the Pacific from shore to shore. The LOW formed near Tokyo on the 21st. By 1200 on the 22d, it was near 36°N, 150°E, at 978-mb pressure. The BEREZNIKI, 300 mi to the south, reported 50-kt winds. At 0000 on the 23d, the LOW had two centers, but this did not slacken the wind speed. Two ships within a few miles of each other both were battered by 60-kt winds. They were the SACRAMENTO MARU and the TOYOTA MARU No. 2. They reported 8- to 12-ft seas and 20- to 26-ft swells. Twelve hours later, the JGIR had 45-kt winds. The 60-kt wind band was still present, even though no ship reported that high a speed, as, at 0000 on the 24th, the LJUBIJA was unlucky enough to find it.

The LOW was moving northeastward and competing with a large LOW to the west for its area of influence. At 0600 on the 26th, the LOW crossed the Aleutian Islands. It was now very weak and part of a trough out of the western LOW. On the 27th, it moved across the Gulf of Alaska and onto the continent, where it could be traced to the Labrador Sea on the 31st.

This storm formed on the same day as the last one, except further west over Manchuria. It started at 1017 mb and was 992 mb by the time it crossed Japan, although still not much of a storm. At 1200 on the 24th, it was at 45°N, 151°E, where it stalled for 24 hr. During that time, the pressure decreased to 972 mb and the circulation occupied the western half of the ocean (fig. 53). At 0000 on the 25th, there was a report of 70-kt hurricane-force winds and two 50-kt storm wind reports. Because the isobars were so closely packed on the analysis, the identity of the 70-kt and one 50-kt report could not be determined. They were both north-northeast of the LOW along the Kuril Islands. The MORI MARU reported 50-kt winds 300 mi south of the center, near 40°N, 150°E. Gale-force winds were in all quadrants. At 1200, Ostrov Paramushir measured 60-kt winds from the northeast. On the 26th, two ships reported 45-kt winds east of Hokkaido. One was being battered by 21-ft seas and 41-ft swells.

The LOW drifted eastward and appeared to use up much of its energy. On the 28th, it started to move northward with a pressure of only 990 mb. The gradient had weakened to such an extent that not even gale-force winds were reported. Also, by this time, other LOWs had formed and were absorbing the system. The gradient to the north of this and another LOW, over the Bering Sea, were still tight as they pressed against a 1057-mb HIGH west of the Bering Strait. A Japanese ship reported violent 60-kt winds near 53.5°N, 179.5°E. The storm was now moving westward across the Kuril Islands and again in the Sea of Okhotsk, where it was lost on the 30th.

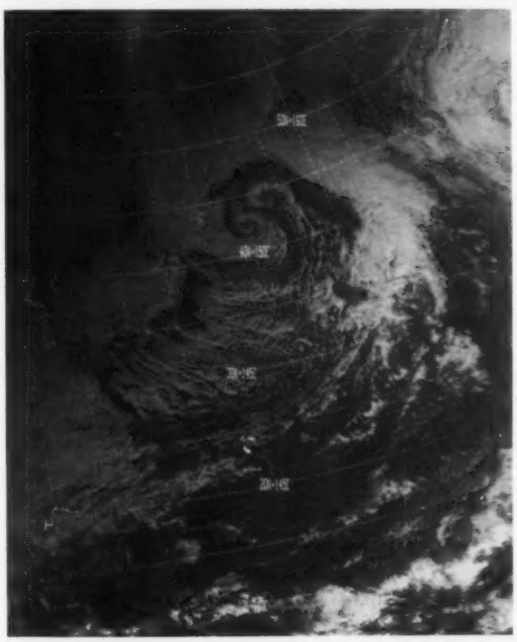

Figure 53.--The cloud pattern indicates a double in this LOW, as it spins off the Kuril Islands.

For the third year in the past four, the western North Pacific's first tropical cyclone formed in January. This year it was Wanda. Wanda was first detected on the 10th, some 350 mi east of Yap Island. She was already a tropical storm, generating 50-kt winds near her center. Gales extended out to nearly 200 mi in all directions, and she was in the process of recurving. By the 11th, Wanda was heading east-northeastward (fig. 54), away from the Philippines. She was also starting to weaken. Winds fell below tropical storm strength by the 12th. The following day, the weak depression moved to the north of Saipan.

Casualties--The first casualty for the month was a 30-ft cabin cruiser which apparently dragged its anchor in winds up to 48 kt and broke up in heavy surf. A 68-ft fishing vessel capsized off the Golden Gate Bridge on the 17th, in turbulent seas. The crew escaped. Massive icefloes from the Sea of Okhotsk trapped 11 ships off the north shore of Hokkaido on the 13th. Most escaped through cracks and leads in the 2- to 6-in thick icefloes.

The 75-ft shrimp trawler JON OLAV was located aground near Jute Bay, Alaska. There was no sign of the four crewmembers. The trawler had sent a May Day message on the 16th, saying the vessel was heavily iced and in danger of sinking.

The CUNARD CHAMPION, from New Orleans, was due Chiba and Kawasaki on the 23d, with heavy weather damage. The 16,005-ton Liberian bulk carrier BONANZA was at Kawasaki on the 30th with heavy weather damage. The American tanker HESSBUNKER (14,126 tons) arrived at Kobe on February 1 from St. Croix with number 7 tank cracked due to heavy weather in the Pacific Ocean.

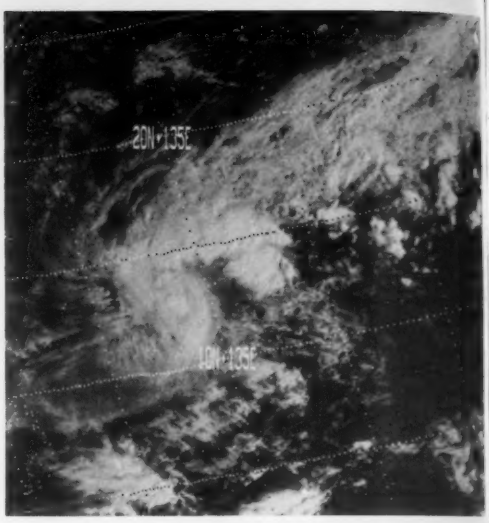

Figure 54.--Wanda moves through seas favored by January tropical cyclones.

Marine Weather Diary

This issue contains the Marine Weather Diaries for 3 mo: March, April, and May. The May and subsequent issues will again have the normal two months, but a month further ahead. With this lead time, both months' climatology should be pertinent when received by the ships.

NORTH ATLANTIC, MARCH

WEATHER. March is a transition month. The weather retains many of the wintry aspects of January and February and at the same time begins to exhibit some features typical of spring. During the first part of March, the weather is generally a continuation of winter conditions, gradually approaching springlike characteristics near the close of the month. However, wide variations from the climatic averages may be expected, and this pattern is not always the rule. The Icelandic Low (1005 mb) rests southeast of Kap Farvel near 58°N, 40°W, while the Azores High contains two 1020-mb centers southwest of the Azores near 27.5°N, between 35°W and 42°W.

WINDS from westerly quadrants generally prevail over the major part of the western North Atlantic north of 30°N. Northerly or northeasterly winds blow more often over the waters between southern Greenland and western Iceland than any other winds from the four cardinal and four intercardinal points of the compass. Winds shift to a southerly component as one moves eastward from 35°W and to variable in direction over the Norwegian Sea east of 5°W. Near the coasts of Morocco and Portugal, northerly winds predominate. South of 30°N, the "northeast trades" are the dominant winds over most of the ocean with few exceptions. East of the Florida coast to about 68°W, wind directions are southeasterly to southerly. There is a strong tendency for easterly and southeasterly winds over the Gulf of Mexico. Over the Mediterranean, westerly to northwesterly winds prevail. For the month as a whole, winds of force 4 to 6 prevail north of 40°N (north of 35°N, west of 40°W) and force 3 to 4 south of 40°N (south of 35°N, west of 40°W).

GALES (force 8 or higher) tend to decrease in strength and frequency during the latter half of March. On the average, gale-force winds have been noted in 10 percent of the ship observations north of a line extending roughly from Cape Hatteras to the Bay of Biscay, excluding the southern Norwegian Sea, the waters south of western Iceland down to 60°N, the seas west of southern Ireland to about 33°W, and the waters east of Newfoundland. A small area of gale fre-

quencies greater than 10 percent covers the Gulf of Lions. The maximum frequency of gale occurrence, 20 percent, may be expected from the southern tip of Greenland south to about 55°N and between 40° and 50°W.

EXTRATROPICAL CYCLONES. Principal storm tracks head from the Great Lakes and the Carolina coast to Newfoundland. From Newfoundland, a primary track curves northward to the west coast of southern Greenland, and another track runs northeastward to Iceland and then into the Barents Sea. Over the Mediterranean area, a primary track extends from the Bay of Biscay east-southeastward to the southern Turkish coast.

TROPICAL CYCLONES. Only one tropical storm, a hurricane in the Lesser Antilles in 1908, has been reported in the North Atlantic in the past 103 yr.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time north of a line from about 150 mi east of Cape Hatteras to Brest, France; in a small area northwest of Barranquilla, Colombia; in the Strait of Otranto between Italy and Albania; and from the coast of Sardinia northwestward to France. A large irregularly shaped area of 20-percent frequency lies in the open ocean bounded roughly by the following coordinates: 60°N, 55°W; 68°N, 25°W; 60°N, 10°W; 43°N, 43°W. Smaller areas of 20-percent frequency lie northeast of Bermuda, west of central Norway, and in the Gulf of Lions.

VISIBILITY less than 2 mi occurs 10 percent or more of the time over a 400-mi-wide elliptically shaped area extending northeast-southwest from 55°N, 40°W to 42°N, 58°W; over an area of the Labrador Sea from Cape Mercy to Cod Island; over the North Sea from southern Norway southeastward to Denmark and Sweden; and north of a line extending from southern Greenland to north of Iceland and then to the Barents Sea.

NORTH PACIFIC, MARCH

WEATHER. March is normally considered one of the transitional months between winter and spring over the North Pacific. Compared to the North Atlantic, weather improvement is somewhat delayed by the vast expanse of the ocean and the lingering winter climate over Siberia. Stormy weather is about as frequent as in the preceding month along the northern routes, especially from the western Aleutians southwestward to the vicinity of Japan. The 1005-mb Aleutian Low lies about 250 mi south of the Komandorskiye Islands and the Pacific High (1022 mb) rests near 33°N, 144°W.

WINDS. From about 40° to 60°N, winds from the westerly quarter are most frequent, although winds are variable north of the Aleutians and easterly over the Gulf of Alaska. In 40 to more than 60 percent of the observations, the wind force is 4 to 6. However, near the North America coast the most frequent wind speeds are force 4 to 5. West to north winds are most prevalent in Japanese waters south of 40°N where more than 50 percent of all winds vary between force 4 and 6. During March, the northeast monsoon continues to prevail along the Asiatic coast south of Shanghai and over Philippine waters. From 25° to 40°N, wind directions are variable, and the force is from 3 to 5 more than 50 percent of the time. The "northeast trades" are the dominant winds from 25°N to the Equator and extend northward to about 30°N over the eastern part of the ocean. The usual wind speeds, force 3 to 5, persist more than 60 percent of the time over the ocean area under the influence of the trades. Northerly force 2 to 3 winds blow 40 percent of the time over the Mexican waters out from the Gulf of Tehuantepec.

GALES. In the central and western North Pacific, gales may be expected as far south as 30°N. In this area, north of 35°N and west of 175°W, 10 to more than 20 percent of ship reports contain winds of force 8 or higher. Over the eastern part of the ocean east of 175°W, there is a large reduction in gale frequencies compared to February, and occurrences are generally confined to latitudes north of 35°N. Percentage frequencies of gales in the central Gulf of Alaska, 10 to 20 percent in the preceding month, drop to 5 to 10 percent during March. Gales over the Gulf of Tehuantepec may be expected more than 5 percent but less than 10 percent of the time.

EXTRATROPICAL CYCLONES. The greatest frequency of cyclogenesis in the Northern Hemisphere takes place in the area off the Ryukyus in March. These storms run northeastward to an area about 250 mi east of Hokkaido where they join another primary track coming from La Perouse Strait between Sakhalin and Hokkaido. East of Hokkaido, the primary paths head northeastward to the western Aleutians where they either continue into the eastern Bering Sea or curve to the east-northeast and parallel the Aleutians and Alaska Peninsula until reaching the Gulf of Alaska. Another track extends from 50°N, 160°W, to the Gulf of Alaska. A storm track heads east-southeastward from the Gulf of Alaska to the Alaska Panhandle.

TROPICAL CYCLONES are infrequent during March. A tropical storm can be looked for once every 2 yr over the western ocean. Half of these tropical storms develop further into typhoons. Tropical cyclones during March usually sprout up east of the central and southern Philippines and west of 170°W.

SEA HEIGHTS of at least 12 ft occur more than 10 percent of the time in a somewhat rectangular area bounded approximately by 50°N and 33°N, and 155°E and 140°W.

VISIBILITY. The southern limit of 10-percent frequency of low visibility (less than 2 mi) extends from Mys Alevina, Siberia, southward to 42°N, 160°E, and then northeastward to west of Kodiak Island. This frequency increases to more than 20 percent from the waters around the northern Kurils northeastward to the Komandorskiye Islands and then northwestward to Mys Ozernoy.

NORTH ATLANTIC, APRIL

WEATHER. During April, weather conditions over the middle and northern latitudes are generally much

more settled compared to the preceding month. Thus, intervals of favorable weather are more frequent and usually of longer duration. There is a notable reduction in the frequency and intensity of winter-type LOWS. The 1007-mb Icelandic Low lies off Kap Farvel near 59°N, 41°W. The Azores High (1021 mb) is centered more than 1,700 mi farther south near 30°N.

WINDS. The prevailing wind north of 40°N is generally from the westerly quarter of the compass except over the Norwegian Sea where winds are quite variable. Within this large belt, about 55 percent of the observations report winds of force 4 to 6. From about 40°N southward to the northern boundary of the trades, the prevailing wind continues to be mostly southwesterly as it was in March, although winds with an easterly component are prevalent off the east coast of Florida out to 70°W and over the Gulf of Mexico. Near the coasts of Morocco and Portugal, northerly winds continue to dominate, and westerly and northwesterly winds continue to hold sway over the Mediterranean Sea. The winds north of the trades and south of the westerlies are weaker than their counterparts north of 40°N--only about 45 percent of all observations yield winds of force 4 to 6. The trades are more firmly entrenched in April as compared to March. They usually prevail south of 25°N and in the eastern North Atlantic extend to about 30°N. Fifty to 75 percent of the time they are of force 3 to 4.

GALES. The area subject to gales compared to March decreases greatly in the middle and northern latitudes. The southern boundary of the 10-percent frequency of gales had moved from 40°N in March to 53°N in April. The gale area extends northward to about 65°N between 15° and 55°W. A small area (about 6° square) of 10-percent frequency is centered east of the Grand Banks near 47°N, 38°W. Gales also spread over the Gulf of Lions about 10 percent of the time.

EXTRATROPICAL CYCLONES. Principal areas of cyclogenesis during the spring months (March, April, and May) are found in a broad area from Cape May down to Georgia on the U.S. East Coast east-northeastward to the central ocean, including the waters around Newfoundland. Within this region cyclogenesis is concentrated from the coast of Virginia and North Carolina northeastward to a point near 39°N, 66°W. Other principal areas of cyclogenesis lie around the south coast of Iceland; over most of the Baltic Sea, including Danish waters but not including the Gulf of Bothnia; off Norway's arctic coast; over the Bay of Biscay; and over the Gulf of Genoa, the northern and central Adriatic Sea, and the southwestern Black Sea. Primary storm tracks in April are much the same as in March. One track begins about 250 mi east of Cape May and travels northeastward over the Grand Banks. The storms heading northeastward across the North Atlantic tend to pass a little farther south of Iceland than in March. Over the Mediterranean, the primary storm track reaches northern Italy, but does not extend to southern Turkey as it did in March.

TROPICAL CYCLONES have not been reported during April in the North Atlantic in the past 103 yr. This is the only month of the year in which no tropical storm activity has occurred.

SEA HEIGHTS of at least 12 ft are found more than 10 percent of the time north of a line extending from Labrador around the eastern margin of the Grand Banks to 41°N, 50°W, westward to 70°W. The same line curves eastward along the 36th parallel to 60°W and then across the North Atlantic to Ireland and central Norway. Another small area of 10-percent frequency extends from the Gulf of Lions southeastward to a distance of 150 mi out over the Mediterranean. An elliptically shaped area of 20-percent frequency extends from latitude 55° to 60°N and across longitudes 15° to 55°W.

VISIBILITY. Occurrences of low visibility increase over the western part of the North Atlantic, especially west of 40°W. The greatest change from March takes place over the Grand Banks and the waters south and east of Newfoundland where over 20 percent of the observations show visibilities of less than 2 mi. Visibility over the Norwegian Sea has decreased in the west and increased in the east. The area of 10-percent frequency of low visibility over the North Sea has moved southwestward and extends from the tip of southern Norway to the coast of Great Britain.

NORTH PACIFIC, APRIL

WEATHER. The weather over the North Pacific generally shows marked improvement over that of any month since October. Compared to the winter months, periods of storminess are fewer, but severe extratropical LOWS are still encountered occasionally. The Aleutian Low has broken down into an elongated 1009-mb trough stretching from east of Kamchatka to the Alaska Peninsula. The 1023-mb Pacific High rests near 32°N, 159°W.

WINDS. Over about half of the North Pacific between 40° and 55°N, the wind speeds are of force 4 to 6 in 50 to 65 percent of the observations. The remainder of this latitudinal belt, especially near the coast of North America, experiences winds of force 3 to 5. The prevailing winds are from the westerly quarter. Between 30° and 40°N, winds are variable west of 170°E, mainly southwesterly between 170°E and 150°W, and westerly to northerly east of 150°W. Forces 3 to 5 are recorded in 45 to 70 percent of the observations. Variable force 5 winds often blow over the western half of the Bering Sea, and northerly force 4 winds are quite common over the eastern half. Easterly winds of about force 4 sweep over the Gulf of Alaska. South of Japan, easterly force 4 winds prevail, and winds from any direction except west and southwest are common over the East China Sea where force 3 to 4 is the rule. The "northeast trades" prevail south of 25° N. over the western ocean between the dateline and the Philippines and south of 30°N over eastern waters. The trades blow at about force 4 except near the Equator and over the Philippine Sea where force 3 winds prevail. The northeast monsoon continues to dominate the South China Sea but with less strength and steadiness than in the colder months. Winds of force 2 to 3 account for between 46 and 63 percent of all observations. Northerly winds continue to prevail south of the Gulf of Tehuantepec but gales over the Gulf now occur less than 5 percent of the time. Force 2 to 3 winds are experienced 5 percent of the time compared to 40 percent in March

GALES. Two areas of high-gale frequencies, 10 to almost 20 percent, persist as a residual of the winter months in the middle and northern latitudes. One holds sway over the Gulf of Alaska south of Kodiak Island to about 53°N, and eastward to near 140°W. The other lies east of Honshu from about 36°N, 147°E, northeastward to about 45° to 48°N, and 178°E.

EXTRATROPICAL CYCLONES. Principal areas of cyclogenesis during the spring months include a large area stretching from south of Hokkaido and the southern Kurils to Taiwan and east-northeastward from the coast of mainland China near Shanghai to nearly 160° E. Most of the Yellow Sea and the extreme western portion of the Sea of Japan are not included within this vast region. Cyclogenesis is even more concentrated from the East China Sea across the Ryukyus to the waters well east of Honshu. Smaller areas of cyclogenesis exist over the eastern Aleutians and the Pribilofs, over the Gulf of Alaska, over an area from the Queen Charlotte Islands to Vancouver Island, and over a section of the east-central North Pacific about midway between the Hawaiian Islands and the eastern Aleutians. While the mean positions of storm tracks during April closely approximate those of the preceding month, there is a northward displacement near Japan and the Kuril Islands. This generally results in fewer gales and better weather over trans-Pacific routes. There is also a decrease in the number of storms that cross the Alaska Panhandle.

TROPICAL CYCLONES. In an average 7-yr period, about five tropical storms can be expected over Far Eastern waters. Almost all of these, about 85 percent, have developed to typhoon strength. Tropical cyclones develop in the same region as they did in March, but the area affected by these warm-core storms has expanded northwestward to include the waters east of Luzon and around Taiwan. A tropical cyclone in the eastern North Pacific in April would be a rarity.

SEA HEIGHTS. The area in which there is at least a 10-percent frequency of 12 ft or higher seas has decreased in size since March. This area now extends eastward only to 150°W. The southern boundary in the eastern portion is 42°N, while the northern and western extent of this area of 10-percent frequency remains similar to that of March.

VISIBILITY. Reduced visibility (less than 2 mi) of 10-percent or greater frequency extends to the north of a line drawn from Sakhalin southeastward to about 40°N, 160°E, and then east-northeastward to about 45°N, 175°W. From there the line swings northward to Amlia Island in the eastern Aleutians and then eastward to about 50°N, 150°W, before cutting back across the Alaska Peninsula to the Bering Sea, east of St. Lawrence Island. The area of 20-percent frequency has decreased in size since March and is now centered over the northern Kurils.

NORTH ATLANTIC, MAY

WEATHER over the North Atlantic continues to moderate during May. The Azores High builds slightly to a central pressure of 1022 mb near 31°N, 40°W, while the Icelandic Low centered several hundred miles southeast of Greenland's southern tip fills to about 1012 mb.

WINDS over the greater part of the ocean between 40° and 55°N are generally westerly, except northeasterly over the Baltic Sea, but with less persistence than during April. The average wind speed north of 40°N is force 4. Winds are quite variable between 55° and 60°N and are generally northerly north of 60°N. Between 25° and 40°N, winds are somewhat lighter, generally of force 3. West of 40°W, within the above latitudinal belt, south and southwest winds tend to prevail; while east of this longitude, winds from the northerly quarter of the compass are by far the most frequent of all. Over Mediterranean waters, west-northwesterly winds of force 2 to 3 are the most common. The Gulf of Mexico plays host to easterly force 3 winds. The "northeast trades," force 3 to 4, dominate the wind regime between 5° and 25°N, except along the African coast where they extend northward to about 30°N. South of 5°N to the Equator, the force 2 to 3 winds almost always have an easterly component.

EXTRATROPICAL CYCLONES continue to develop frequently from off the Carolina coast northeastward to Newfoundland, but are less severe than during April. The direction of movement from Newfoundland is generally either north toward the Davis Strait or northeast toward the Norwegian Sea. Two primary tracks affect the Great Lakes. One runs east-southeastward from Lake Winnipeg to south of James Bay. Another follows a line from eastern Iowa across southern Lake Michigan and southern Lake Huron to lower Quebec. After meeting, the two tracks proceed as one to the Gulf of St. Lawrence.

GALES are rare below 40°N, and their frequency and duration in higher latitudes are less than in the preceding months. The area of maximum likelihood of gales, 10 to 20 percent, generally is located from the southern tip of Greenland southward to about 52°N between 40° and 56°W.

TROPICAL CYCLONES are infrequent during May. During the 43-yr period 1931-73, nine tropical storms occurred, and two of these attained hurricane force.

SEA HEIGHTS of 12 ft or more are encountered from 5 to 10 percent of the time along the northern shipping lanes from several hundred miles east of the Chesapeake Bay to the northern Norwegian coast, excluding the North Sea and the Bay of Biscay but including the Gulf of Lions southeastward to Sardinia. The frequency increases to more than 10 percent in the midocean area and to more than 20 percent south of Kap Farvel.

VISIBILITY limited to less than 2 mi is encountered 10 to 20 percent of the time over the western North Atlantic from about 40°N, 65°W, northeastward to a point near 53°N, 30°W, and then westward to the Labrador Sea. The line, north of which frequencies are greater than 10 percent but less than 20 percent, then extends northeastward over Kap Farvel to north of Iceland and through the Norwegian Sea to the Barents Sea. Visibility less than 2 mi also occurs between 10 and 20 percent of the time over a great

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part of the northeastern North Sea. Frequencies increase to over 20 percent of the time over the Grand Banks and off the southwest coast of Greenland.

NORTH PACIFIC, MAY

WEATHER continues to improve slowly over the North Pacific in May. The subtropical High has an average central pressure of about 1022 mb and is located near 34°N, 152°W. The Aleutian Low becomes a broad weakening trough extending from the Asia mainland eastward to the western Gulf of Alaska. The lowest pressure, about 1008 mb, is centered over the west-central Bering Sea.

WINDS north of the 25th parallel tend to come from the westerly quarter of the compass, but variable winds are present over a number of locations on either side of the dateline. Winds over the Gulf of Alaska are easterly at force 3 to 4. Along the U. S. coast, northwesterly components are pronounced. Between the Equator and 25°N, (30°N, east of 180°), the "northeast trades" are very steady, except over the southern half of the South China Sea where southerly winds of the southwest monsoon have established themselves. These monsoon winds are usually force 2 to 3, though lighter winds are not unusual. Over most of the rest of the North Pacific, wind speeds average force 3 or 4. Northerly and westerly winds prevail out from the Gulf of Tehuantepec with easterly and northwesterly winds close behind. Speeds are force 2 or 3 48 percent of the time.

EXTRATROPICAL CYCLONES continue to develop over the Ryukyus and then move east-northeastward toward the Gulf of Alaska. A second primary storm track crosses the Siberian coast and Sakhalin, continues eastward across the northern Kuril Islands, and then curves toward the southern Bering Sea.

TROPICAL CYCLONES. Tropical storms occur, on the average, about once each year over the western ocean. There have been years with none, and some years with as many as four. Roughly 85 percent of these tropical storms become typhoons. The areas of most frequent development are south of 20° N. from the Carolines westward across the Philippines and the South China Sea. About once every 2 yr, a tropical storm or hurricane develops over the ocean area off Mexico during May.

SEA HEIGHTS of 12 ft or more are encountered from 10 to less than 20 percent of the time in two areas south of the Aleutians and north of 45°N. One area is bounded roughly by the ellipse formed by the points 52°N, 46°N, 170°E, 165°E; another larger area proceeds southeastward from Atka Island to 45°N, 160°W. N., 160° W.

VISIBILITY less than 2 mi occurs more than 10 percent of the time over the western North Pacific Ocean north of 35°N and over the eastern North Pacific Ocean north of 42°N and west of 140°W, excluding the Gulf of Alaska and the waters southeast of the central Aleutians. Over the northern Kurils this low visibility occurs more than 30 percent of the time.

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